Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXVI. NEW YORK, SATURDAY, OCTOBER 20, 1900. No. 16.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - - 936 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.
PARIS, - - - - - - - - - - Electricity Building, Paris Exposition.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.
CARL HERING, - - - - - - - - - - - - - - Special Contributor.

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ELECTRICAL WORLD AND ENGINEER.

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The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

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United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
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Entered as second-class mail matter at the New York Post Office.

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FAME.

The University of New York has a Hall of Fame and has been securing ballots from distinguished people for the names that should be tabletted on the walls thereof. It was hardly to be expected that George Washington would be forgotten, but we are glad to see that S. F. B. Morse is included. The soldier, statesman and philanthropist often get credit for the work that the inventor and the engineer have done. It is one thing to formulate the Ten Commandments. It is quite another thing to devise the means and methods which render it possible for the bulk of mankind to live within the borders of the law. That is chiefly the work of the engineer and inventor, not of the lawgiver. It heartens us to see Fulton, Whitney and Howe also among the eligible worthies. It pains us to see the omission of Joseph Henry. A novelist or judge could be spared to make room for him.

THE WESTERN UNION ANNUAL.

Note is made elsewhere in this issue of the main features of the Western Union annual report. The showing for the year is fairly satisfactory, and there was an increase of about 1,750,000 in the number of messages handled, the total being slightly over 63,000,000. The average toll per message was 30.8 cents, and the average cost was 25.1 cents, exactly the same as in 1899. There have been rumors that the company will cut its dividend rate, but the last balance sheet can hardly be said to reveal any necessity for doing that.

It is supposed that the Western Union Telegraph Company does the bulk of the business, but there are evidences that the volume on the railroad service is wellnigh as large and almost as expensive. According to the returns of the Interstate Commerce Commission, the railroads of this country spent last year on their telegraphs the magnificent sum of $15,525,232. The operating expenses of the Western Union were $18,593,206. The railroads employ nearly 24,000 operators and dispatchers, and spent last year $1,153,408 in repairs and renewals of their telegraph system. No separate figures are given for railroad telephone service, but as yet it does not amount to much.

SOME STANDARD DATA ON HORSE WORK.

When we wish to determine the relative commercial value of a new commodity, we cast about for a standard of comparison. Sometimes, however, the gauge sought is not at hand, and we must, perforce, collect our own material and shape it into the measure desired. When this has been accomplished, the way is made easy for those who follow. That such a condition existed in the automobile field until to-day we know, for no standard of comparison has, up to the present time, been published by which one could determine with any degree of accuracy the exact commercial position of the automobile as compared with any one of the horse systems with which it may be expected to compete in the near future. To-day, however, we present to our readers some remarkable data which may be used as a standard for comparing automobile and horse systems. In the careful compilation of this data Mr. Fliess has done an admirable piece of work.

In the installment of his report on "The Electric Automobile from a Commercial Point of View" which we publish to-day will be found much unfamiliar data on light horse delivery systems as maintained by the large department stores in this city. The data

presented give a clear idea as to the nature of the work required of units engaged in this class of service; and, in conjunction with the preceding part of this report—published in our last two issues—they afford for the first time an opportunity for determining the commercial position which the electric automobile has now reached. In to-day's installment will be found some data on the loads that vehicles in this class of service must carry; the average speed of a vehicle while in motion under our present traffic conditions is considered; also the amount of work done by horses in this class of service, etc. A large amount of data is presented on the distance traveled in light delivery service in the Borough of Manhattan, which has not been available before; and the cost of this service is given. The data and results that are contained in this part of the report will, we believe, prove very valuable and intensely interesting to all interested in the present horseless vehicle movement, whether they advocate steam, gasoline, electricity or any other means of mechanical locomotion in place of the horse. We take this opportunity of thanking the large dry goods department stores, livery stables and other institutions that have assisted in rendering Mr. Fliess' arduous task a little easier, and can only commend their public spirit.

It is to some of us a singular coincidence that this serious investigation as to the ability of horses still to compete with mechanical traction should be published during the present week, when the American Street Railway Association is in session at Kansas City. There was a time, not so long ago, when that body had quite some reluctance, openly expressed on the floor, to discussing anything but horses and manure. The times have changed since then, and now any one who got up and wanted to discuss anything but mechanical traction would be promptly turned down for introducing an utterly irrelevant topic. From this remarkable change in a great industry, the happiest augury may certainly be drawn as to the future of the automobile. These figures of Mr. Fliess, while doing the fullest justice to the horse, and presenting his case in the most favorable light, may yet be found to mark the point of new departure. It is not "where you are at," but whither you are tending that counts. These figures show the horse at its best. Automobile traction is still at its worst.

NOMENCLATURE OF ELECTRICAL APPARATUS.

An interesting article by Mr. Steinmetz appears on this subject in another column. A proper and consistent terminology and nomenclature are not only desirable, but also important. They contribute to precision and at the same time avoid ambiguity and misrepresentation. It is pointed out that the division of electrodynamic machinery into motors and generators is a functional rather than an organic classification. In many instances an engineer would be unable to determine from a mere inspection of a machine whether it was intended to be used as a generator or as a motor. While such a division may be useful after the machine has been set in operation, there should exist a classification to which all machines might be referred without regard to their operation either as generators or as motors.

A very common but unfortunate title is that of rotary converter—and the adjective should be dropped from the catalogue, the word "converter" being sufficient. The term rotary converter, on being abbreviated, sometimes degenerates into "rotary," which is terrible to sensitive ears that are tuned to the distinctions between nouns and adjectives. A peculiarity of the classification adopted by the standardizing committee of the American Institute of Electric Engineers, and here advocated by Mr. Steinmetz, is the fact that the so-called "unipolar" direct-current machine is excluded from the main divisions of machinery, and left to itself. This is really a blessing in disguise, because the differences which exist between the nature and structure of the non-polar dynamo and the ordinary direct-current dynamo, are sufficiently marked to entitle the machine to a class by itself.

When a commutating machine is inserted into a supply circuit as a generator to raise the pressure already there existing, it is commonly called by the graphically descriptive, although doubtfully elegant title of "booster." We have an idea that Mr. L. B. Stillwell, whose engineering phraseology is remarkably correct, is responsible for that expressive word. Mr. Steinmetz intimates that when the same machine is inserted into the circuit as a motor and to act as an anti-booster, or to depress the pressure, it becomes a *motor*. We think that this title is insufficient, and is liable to misinterpretation. A better term would be the one already in fairly general use, namely, "crusher." This is also an inelegant term, but not more so than "booster," and it is at least signally descriptive. We hope to see the nomenclature of the article obtain the widest circulation.

PACIFIC CABLES.

We notice that the specifications for the British submarine cables in the Pacific are now published. They call for the construction of more than 8000 nautical miles of submarine cable to connect the British colonies of Canada, Australia and New Zealand. This is an appreciable addition to the world's present total of 175,000 miles of submarine cable. The actual distance from Vancouver to Queensland is about 6700 miles, but the cable allowed for this distance, including the necessary slack and reserve, is 1000 miles more, or 7700 miles. Only about 500 miles extra is required to loop in New Zealand.

The weak feature of the whole enterprise from the point of view of the telegraphist is the great variation in the lengths of the sections. Owing to the fact that there is no British territory in the immediate southwestern neighborhood of Canada, the section from Vancouver in Canada to Fanning Island near the equator, is an uninterrupted stretch of 3200 miles, on which 14 per cent excess is allowed, making the length of cable required 3653 miles. All of this cable may not have to be laid, but the finished cable will probably not be much less than 3600 miles in length, and will be the longest cable in the world. From Fanning, the cable is intended to go to the island of Suva in the Fiji group, a distance of only about 1900 miles, while the continuation of the route is to be through Norfolk Island and thence to Moreton Bay, Queensland, and also to New Zealand, all comparatively short distances.

The long section to Fanning Island is intended to have 600 pounds of copper and 340 pounds of gutta-percha per nautical mile, with a resistance of not more than 2.03 B.A. ohms at 75 degs. F., and a capacity of not more than 0.44 microfarad per mile. It is curious to see B.A. ohms appearing in a modern specification. It is to be supposed that the B.A. ohm is used because the cablemakers have been accustomed to it, and most of the existing tables upon the electrical properties of submarine cables employ the B.A. ohm as the unit of electrical resistance. This is, however, only an evidence of mental inertia that ought to be overcome. In fact, it is a matter for debate as to whether a contract involving B.A. ohms would be legal in Great Britain, where the International ohm is the Imperial ohm, unless special provision were made for the same. But after all in a country, which, like the United States, uses the inch, grain, pound, gallon and a small host of other barbaric units, a little extra ancient history preservation in electrical units does not much matter.

The KR product of this cable, or its electrical time-constant, will be about 10.5 seconds, or double that of the average Atlantic cable. The speed of this section will control the speed of the entire route, so long as no duplicate cable is laid. The conductor is to consist of one large central copper wire covered with a helix of smaller copper wires. This is like the conductor of the most recent Atlantic cables, and is an important feature. In the early days of submarine cables only a single copper wire was employed. This was found to be dangerously liable to rupture, with consequent loss of continuity and serious expense. A strand of seven equally sized copper wires was then the unvaried rule for a number of years. But even such a strand will be liable to total discontinuity under the action of continued flexure and reflexure. The most recent practice is that called for in these specifications, and is a partial return towards the original single wire, the advantage being that the conductor is rendered more compact or has a smaller diameter for the same conductivity, as well as being stronger mechanically; while the thin covering wires are capable of a great deal of flexure without breaking.

The objectionable 3600-mile telegraphic span across the Pacific is only rendered necessary by British imperial considerations, for if the United States should bridge that ocean with a cable, the longest span would be only about 2100 nautical miles of distance. What a grand argument against Imperialism this should be for somebody!

THE QUESTION OF PERIODICITY.

The valuable paper by Mr. C. P. Steinmetz which we brought to an end in our columns last week is one which will repay careful study. In such study it is well to bear in mind that it was read at the Edison convention, and is written in a certain measure from the standpoint of their particular needs and methods. Hence, one should not attempt to read all its conclusions into general practice without examination of the statements in all their aspects, for it will be found that Mr. Steinmetz, before letting go the subject, covered his ground very carefully, and himself has actually drawn distinctions which the casual reader might fail to appreciate. The chief topic of the discussion was the bearing of periodicity on the applications of the alternating current, a subject often broached but seldom examined with such critical care. All the early work on alternating currents in this country was done at a frequency of 120 to 135 cycles per second, a range of periodicity well suited to the production of cheap transformers for a house-to-house distribution. As soon as power transmission or distribution on a large scale was attempted, this high frequency led to difficulties of varied and uncomfortable sorts, and the result of experience has been to drop the standard frequency for ordinary apparatus to 60 cycles per second—a figure first chosen in the forlorn hope of utilizing 125-cycle transformers, but which led to the production of most admirable transformers for the lower frequency. The controlling factor in the reduction of frequency was, however, the use of induction motors, which were early found to be highly unsatisfactory on the frequencies originally in use. Without going too deeply into this phase of the matter, high frequency motors require extreme multipolar construction if of practicable rotative speed, and this in conjunction with the increased normal inductance due to increased frequency, leads to great difficulty of design, and bad qualities generally.

With the introduction of the rotary converter another impulse downward was given to the frequency. As Mr. Steinmetz very shrewdly points out, the difficulty of high frequency rotaries lies in the simple facts of commutator speed and design. Were it not for this hitch, all the minor points to which Mr. Steinmetz refers would have little practical bearing. But conservative commutator design for continuous current machines pointed to low frequency, and but for the fact that the rotary is inseparably tied to its bank of transformers, the frequency of that apparatus would be probably lower than it now is. Nevertheless we must beg to differ sharply with even so accomplished an engineer as Mr. Steinmetz on the desirability of keeping rotaries down to a frequency of 25 cycles. It is a perfectly well known fact that they can be made successful even at 60 cycles, and even on Mr. Steinmetz's figures for a 27-cycle converter, a reduction of the width of the commutator bars to one-fourth inch, with a corresponding increase in length to get the surface, and in depth to get area, would lead to a good result at 40 cycles; while very trivial changes would make a good converter at 35 cycles. The point which we wish to make is this: There is no valid excuse for putting out alternating apparatus at a standard frequency below that at which incandescent lamps can be easily and conveniently operated. This frequency, taking into account the kind of incandescent lamps now in general use, is certainly above 30 cycles per second, and as certainly below 40 cycles. The changes required in the construction of rotaries to make them as practicable at 35 cycles as they now are at 25 cycles are well known now to be trivial and not of great cost—in fact, including the transformers, of very little extra cost; and the gain of being able to work lights off the alternating mains is actually great, although *ex officio* the Edison companies are not deeply interested in that phase of the matter. And as regards direct coupled alternators, a comparatively small change, either in number of poles or in speed, would carry the frequency beyond the critical point for incandescents. Very many engines used for direct connection are needlessly slow in speed. The fact is that the engine builder has dominated the contract, or the man who drew the specifications thought less of electrical than mechanical matters—hence the electrical designer is handicapped.

But another feature of the frequency case is found in arc lighting. Alternating arcs work, it is true, at 40 cycles, but, as Mr. Steinmetz remarks, they work better at 60, and still better at 125. They can even be operated below 40 cycles, but the minima of light are strongly marked, and a shocking tale is told of the weird centipedal effects produced at the first appearance of the *corps de ballet* in a theatre experimentally lighted with low frequency arcs! The importance of the alternating arc in determining the frequency desirable in a system is at present not very great, for indoor lighting by such arcs is still in rather bad shape, although steadily on the mend. It is, at all events, clear that there is no common frequency at which both rotaries and alternating arcs will do first-class work. As regards induction motors, they do admirable work anywhere between 25 and 60 or 70 cycles, the lower frequencies being the better if very low rotative speeds are required.

As Mr. Steinmetz's paper clearly points out, there is no such thing as a best frequency for all purposes. Probably something between 40 and 50 cycles would come as near a fair compromise as may be, but this would be a shade high for big rotaries and a little low for arcs. At present, however, there is no uniform practice in the matter of frequency. A glance at a list of plants shows all sorts of variations between 25 and 66 cycles. There is no need of such an amount of special frequencies. They are a nuisance to the manufacturer and prevent such standardization as facilitates quick deliveries and prompt repairs. The companies could in no way exercise their conjoined influence more usefully than by getting together and suppressing the indefinite specialization that is the bane of recent work. If a shoe manufacturer got an order for a case of No. 11⅜ brogans with French heels and a separate pocket for the big toe, his remarks to the guilty salesman would be unprintable in a respectable family paper like the ELECTRICAL WORLD AND ENGINEER. But the electrical manufacturer seems to suffer in silence, and there is no balm for his soul.

Western Union's Year.

The annual report of the Western Union Telegraph Company shows gross earnings of $24,758,569, an increase of $804,250; net earnings of $6,165,363, an increase of $296,631, while the surplus, after the payment of dividends and the setting aside of $9,797 as a sinking fund appropriation, shows an increase of $287,586, the total being $391,278. The lines of the company were increased during the year by 2849 miles of poles and 28,520 miles of wire. There was also an increase of 615 offices. The number of messages transmitted was 1,769,626 greater than for 1899. The increase of $804,257.50 in the revenue for the year was made up principally of $457,864.77 from regular commercial messages, $76,628.06 from press dispatches and $197,665.12 from leased wires; the balance of $72,099.55 was derived from sundry minor sources of income. As compared with the preceding year, the various classified items of expense were increased as follows: For operating and general expenses, $265,243.89, incident to the larger number of messages transmitted and delivered, and to the operation of more offices; for maintenance and reconstruction of lines, $206,585.94, partly for cable repairs in the Atlantic, but chiefly for the replacement of old and defective lines with new poles and copper wires, and for the equipment, $48,163.46, on account of new wires and offices. The rentals of leased lines and the payments for taxes were but slightly changed. The total increase in expenses for the year was $507,626.68. After paying the interest on the bonds and the dividend of 5 per cent, there was added to the surplus account $391,277.33, or $287,584.92 more than was carried to that account in 1899. The average tolls received were 30.8 cents per message, and the average cost per message was 25.1 cents, these figures being the same as for 1899. These averages, it should be borne in mind, are confined to the messages transmitted for the public and the press by the employees of the company. They are arrived at by eliminating from the total receipts the revenues from all other sources, and by charging against them only their proper share of the total expenses for operation, maintenance, etc. During the year $1,199,587 was expended for the purchase of sundry lines and the construction of new property, and $70,000 was paid out for patents. The weekly reports of receipts continue to show a healthy condition of business, and indicate satisfactory returns for the current year, if no unlooked-for setback occurs.

E. Harriman and Charles Lockhart have been elected directors of the Western Union Company, succeeding Alonzo B. Cornell and C. P. Huntington, deceased.

Rights of Motor Vehicles.

The question as to the rights of a motor vehicle on a public highway was raised in the Bergen County Court at Hackensack, N. J., recently, and Justice Jonathan Dixon, of the New Jersey Supreme Court, in charging the jury, interpreted the law bearing upon the issue raised. As the question depends not upon the construction of statutes, but upon the application of principles of common law, the justice's analysis applies with equal force in this State.

The suit was for damages for the death of Mrs. John L. Guyre, who died from injuries received by being thrown out of her carriage at Midland Park, N. J., her horse having taken fright at a motor vehicle operated by Dr. William L. Vroom. After taking 23 ballots the jury reported its inability to agree upon a verdict.

The prosecution having made the contention that the motor vehicle was a nuisance and had no rights upon a public highway, Justice Dixon charged as follows:

"The question is whether the machine driving along the country roads without a horse in front and discharging steam behind is so likely to frighten a horse on the highway and thus endanger the road as to constitute the machine a nuisance. It is argued that it is an improved method of locomotion, but it does not follow that it is to be tolerated. The right to drive horses along the highway is an established right, a common right, and if a modern method of locomotion is used of such a nature that it commonly brings discomfort and danger to those exercising the common right, the established right of travel on highway, then it is a nuisance and cannot be tolerated. But it does not follow it is a nuisance because it occasionally or exceptionally frightens horses. That would not make it a nuisance. In order to make it a nuisance its common effect must be to substantially interfere with the people who drive horses along the highway. Is it of such a nature that it is so likely to frighten horses and thus endanger travelers on the highway as to make it a nuisance, or is it only its exceptional effect? If it is its common effect, then it is a nuisance; if exceptional effect, it is not a nuisance. If this method of locomotion is a common nuisance, and was the approximate cause of death, then the defendant is responsible."

Fire at Postal Telegraph Headquarters.

On the night of Oct. 16, during Candidate Bryan's visit to New York City, and when the wires were loaded with business, fire was discovered in the Hardware Club, at the top of the Postal Telegraph Building on Broadway. The club occupies a top floor above the operating rooms of the telegraph company, and hence it was not only difficult to get at the fire, but there was great risk of an entire suspension of work by the telegraph force. Smoke and water filled the room, driving the operators from their posts and causing the fine big switchboard to be covered. Some of the electric elevators were also flooded out. But the fire was promptly taken in hand by the firemen, and the operators got back to their keys, and, with the aid of umbrellas and mackintoshes, resumed their urgent task with great zeal and a coolness that was alike physical and mental. So far as can be learned as we go to press, the only damage to the telegraph equipment was from possible soakage, but it was very gratifying to note how swiftly work was resumed and the hooks cleared of dispatches for which papers in all parts of the country were waiting.

Electricity in the Recent Naval Manoeuvres.

The Navy Department has received Rear-Admiral Farquhar's report of the recent manœuvres of the North Atlantic squadron off Newport, R. I. The exercises proper began on Sept. 24, when the Red Squadron, consisting of the Kearsarge, Indiana, Texas, Scorpion and Eagle, accompanied by six torpedo boats, put to sea to effect a blockade of Newport. The remaining vessels, the New York, Massachusetts, Leyden and Vicksburg, were stationed as defenders of the harbor and constituted the Blue Squadron. The general plan of defense followed by this inside squadron was to place a battleship on each side of and just inside the mouth of the harbor, so as to be concealed from incoming vessels. Here, with decks cleared for action, batteries trained forward and full steam up, the New York and the Vicksburg lay in wait, ready to fire into and ram any venturesome member of the Red Squadron. Picket boats, armed with rapid fire guns and sharpshooters, were provided with a system of signals to warn all hands of the approach of the enemy, and powerful searchlights at Fort Greeble and other points insured protection at night. The general plan followed by all vessels was not to turn on searchlights until the approach of a torpedo-boat was reported by picket boat. The plan of placing picket boats was very successful, and not a single torpedo-boat got by them without being reported. With a sufficient number of searchlights on shore it is doubtful if vessels could be piloted at night into a harbor that was at all difficult of entrance.

The bow-wave and wake of torpedo-boats was the first object that aided in picking them up in the darkness. "In this connection," says the Rear-Admiral, "I would suggest the advisability of the Department's keeping as many torpedo-boats or destroyers as practicable with the squadron at all times, to accustom both officers and men with their general characteristics, movements, etc., and in order to carry on exercises with them in all the various ports visited."

The submarine boat Holland, unfortunately, in her attack upon the Kearsarge, the second night, did not reach her objective point until after several torpedo-boats had arrived. The second night's operations consisted in an attack upon the outside, or Red Squadron, by five torpedo-boats and the Holland. As a rule the torpedo-boats were successful, although this would scarcely have been the case with an efficient picket-boat service. Every condition of battle was simulated as nearly as possible, although blank charges from the small rapid-fire guns constituted all the firing. While much was wanting, says Admiral Farquhar, both in time and material, to carry out the manœuvres on a large scale, still a number of professional points were brought out which will be of great value in the future. The value of searchlights was particularly impressive, as was also the work done by the Holland, of which Capt. Folger says in an additional report: "The Holland type will play a very serious part in future naval warfare."

The Electric Automobile from a Commercial Point of View—II.

Some Data on the Cost of Light Horse Delivery Service and on the Amount of Work Such Horses Do.

By Robert A. Fliess, E. E.

THE object of Part II of this investigation is to present the results obtained in an effort to determine as closely as possible the nature and amount of the work required of horses engaged in the light delivery service of some of the large department stores in New York City, and to determine the cost of such service.

In the course of this investigation data were collected from a number of such stores in the city as to cost of operation, maintenance, etc., all of which have been closely compared. As a result of this comparison it has been decided to present only the specific data obtained from one of these stores as to cost of operation, etc.—a consideration of the other data at hand indicating that they present practically the lowest figures obtainable in the city in this class of service. Hence, when used as a basis of comparison, the results obtained, it is thought, may be relied upon as conservative. Another point which adds to the comparative value of this data is that the unit districts into which the delivery routes of the store selected are divided cover more ground than those of any of the other stores considered—the horses of this concern thus actually covering more ground than those engaged in the service of the other stores and at a less cost.

In determining the cost of delivery service, all items properly belonging in the expense account of the delivery department should be considered. But, as the principal object of this investigation was to obtain data for comparative purposes, all items of expense common to the operation and maintenance of the two systems were neglected.

It may be well to remark that all data incorporated in this article on cost of operation, etc., were obtained directly from the books of several large corporations in this city. All the other data presented were obtained at first hand by the writer.

NATURE OF WORK REQUIRED IN LIGHT DELIVERY SERVICE.

That those who are not familiar with the nature of the work required of horses in light delivery service may be in a position to better appreciate the value of the data presented, the method adopted by the large department stores in handling goods which are "to be sent" will be explained.

Take, for example, one of the big department stores located within easy reach of the Eighteenth Street station of the Sixth Avenue Elevated. When a purchase has been made by a customer who wishes to have the goods "sent," the delivery department is the means through which that end is attained. The address to which the package is to be sent may be practically anywhere. We will assume it to be within the Borough of Manhattan, however.

After passing through several hands, the "goods" in due time reach the assorting table in the delivery department, its destination marked on the package.

As many hundred packages are handled by the delivery departments of these stores each day, the destinations of which are widely scattered, it is evident that a highly organized system of distribution must be kept in constant and uninterrupted operation. The system now universally employed utilizes a number of small units, each of which has a particular district assigned to it within which its function is to distribute all packages the addresses of which locate them in its precinct. The number of such districts for each store is determined by the volume of its business. The greater the number of packages to be delivered, the more numerous become the districts for any particular store. The several factors which determine the size of each district are the number of packages that must be delivered within it each day, its location with respect to the store and the character of the neighborhood in which the district is situated.

The division of the Borough of Manhattan into unit districts for the store under consideration is given in Table I:

TABLE I.

		Deliveries per day.
1.	Canal Street to Battery, east and west	1
2.	Canal Street to Nineteenth Street, east of Fifth Avenue	3
3.	Canal Street, to Nineteenth Street, west of Fifth Avenue	2
4.	Twentieth Street to Forty-fifth Street, west of Seventh Avenue	3
5.	Twentieth Street to Fifty-ninth Street, Fifth to Seventh Avenue	3
6.	Twentieth Street to Forty-second Street, east of Fifth Avenue	3
7.	Forty-sixth Street to Sixty-fifth Street, west of Seventh Avenue	3
8.	Forty-third Street to Sixtieth Street, east of Fifth Avenue	3
9.	Sixty-first Street to Eightieth Street, east of Fifth Avenue	3
10.	Sixty-sixth Street to Eightieth Street, west of Eighth Avenue	3
11.	Eighty-first Street to 105th Street, east of Fifth Avenue	2
12.	Eighty-first Street to Ninetieth Street, west of Eighth Avenue	3
13.	Ninety-first Street to 102d Street, west of Eighth Avenue	2
14.	103d Street to 115th Street, west of Fifth Avenue	2
15.	116th Street to 130th Street, west of Fifth Avenue	2
16.	131st Street to 155th Street, west of Fifth Avenue	2
17.	106th Street to 145th Street, east of Fifth Avenue	2

It will be seen from this table that the Borough of Manhattan in this case is divided into seventeen unit districts.

In the delivery department, conveniently located with respect to the assorting table on which we left our package, are a number of compartments, each separated from the other by a suitable partition. Every unit district in Table I has assigned to it one of these compartments, and into the one representing the district within which the address of our package lies, it is thrown.

The package remains there until a specified time, when it becomes the duty of the delivery boy working on the route corresponding to the compartment into which the package was thrown, to collect it, together with the rest of the packages that have accumulated there since the last delivery on this route, and carry them to the delivery wagon backed up against the curb, waiting to receive its load.

All stores have scheduled times at which their delivery wagons are supposed to start cut upon their routes. The time of departure varies, naturally, with different stores, and in the same store with different routes. Take, for example, Districts Nos. 12 and 13, Table I. In the case of the first mentioned route the wagon is supposed to leave the store at 8 a. m., 1 p. m. and 5 p. m. On route 13 it leaves at 8 a. m. and 3 p. m.

The wagon, having received its load, starts on its trip. The distance which it must go before reaching the section of the city in which its district lies depends upon its route. Table II shows the different distances that the vehicles covering the routes specified in Table I have to travel before and after making their deliveries.

TABLE II.

Route.	Miles traveled before delivery, loaded.	Miles traveled after delivery, unloaded.	Distance that must be covered on each trip.
1.	1.75	1.75	3.50
2.	0.47	0.47	0.94
3.	0.00	0.00	0.00
4.	0.00	0.00	0.00
5.	0.00	0.00	0.00
6.	0.41	0.41	0.82
7.	1.52	1.52	3.04
8.	1.595	1.595	3.19
9.	2.47	2.47	4.94
10.	2.785	2.785	5.57
11.	3.45	3.45	6.90
12.	3.50	3.50	7.00
13.	4.00	4.00	8.00
14.	4.57	4.57	9.14
15.	5.11	5.11	10.22
16.	5.36	5.36	11.72
17.	4.72	4.72	9.44

It will be seen from Table II that in the case of route No. 16 the wagon must travel a minimum distance of 23.44 miles per day before and after its delivery—there being two deliveries a day on this route.

The wagon, having reached the point at which its deliveries begin, travels back and forth at the discretion of the driver. Each driver has his own method of covering his district. The object of each one is to make his deliveries in as short a time as possible and with the least amount of work for his horse. Therefore, in general, "back loading" is resorted to. This means that the driver sends his delivery boy in one direction on foot with a number of packages to deliver, while he drives in another direction, makes some deliveries and waits for his boy to join him at some previously arranged spot. In this way the horse is saved much work and the time required to complete the delivery is much shortened. All deliveries having been made, the wagon returns to its stable.

Two horses for each single horse delivery wagon is the usual allot-

ment in large stables, the work being divided between them. On routes calling for three trips a day, one horse makes one trip one day and two the next. On the two-trip routes each horse makes but one trip a day.

TABLE III.

REMARKS.	Time. Hours. Minutes.	Cyclometer Readings. Miles.	Number of deliveries made while wagon was at rest.	Number of persons engaged in making the delivery	Time wagon was at rest or in motion. Minutes.	r—rest. m—motion.	Distance traveled in miles between stops.	Speed in miles per hour while in motion.
Stopped to make a delivery	10.25	620.61	1	1	....	.....	....	....
Started again	10.32	.....	....	....	7	r	....	....
Stopped to make another delivery	10.33	620.73	2	2	1	m	0.12	7.2
Started	10.37	.....	....	....	4	r	....	....
Stopped	10.38	620.95	1	1	1	m	0.22	13.2
Started	10.40	.....	....	....	2	r	....	....
Stopped	10.40¼	621.00	1	1	0.25	m	0.05	12
Started	10.46½	.....	....	....	6.25	r	....	....
Stopped	10.48½	621.18	1	1	2	m	0.18	5.4
Started	10.50½	.....	....	....	2	r	....	....
Stopped	10.52	621.32	2	1	1.5	m	0.14	6.2
Started	10.56¾	.....	....	....	4.75	r	....	....
Stopped	10.57¾	621.36	1	1	0.5	m	0.04	4.8
Started	11.01½	.....	....	....	4.25	r	....	....
Stopped	11.03	621.51	3	1	1.5	m	0.15	6
Started	11.10	.....	....	....	7	r	....	....
Stopped	11.11½	621.695	1	1	1.5	m	0.185	7.4
Started	11.14	.....	....	....	2.5	r	....	....
Stopped	11.16	621.925	1	1	2	m	....	6.9
Started	11.17½	.....	....	....	1.5	r	....	....
Stopped	11.19¾	622.04½	1	1	1.75	m	0.12	4.1
Started	11.22	.....	....	....	2.75	r	....	....
Stopped	11.22¼	622.08	2	1	0.25	m	0.035	8.4
Started	11.24½	.....	....	....	2.25	r	....	....
Stopped	11.26	622.33	2	2	1.50	m	0.25	10.0
Started	11.28	.....	....	....	2.00	r	....	....
Stopped	11.29½	622.46	2	1	1.5	m	0.13	5.2
Started	11.40¾	.....	....	....	11.0	r	....	....
Stopped	11.42½	622.665	1	1	2.0	m	0.205	6.15
Started	11.46	.....	....	....	3.5	r	....	....
Stopped	11.47½	622.765	2	1	1.5	m	0.1	4
Started	11.50	.....	....	....	2.5	r	....	....
Stopped	11.52	622.925	2	1	2.0	m	0.16	4.8
Started	11.55	.....	....	....	3.0	r	....	....

Table III presents the analysis of an hour and a half in the routine work of a certain delivery wagon. It may be taken as a fair representation of the nature of the work required in delivery service. The table shows that in 1 hr. and 30 mins. the wagon covered but 2.315 miles; that in that time but 25 deliveries were made, and that the wagon was at rest 1 hr. 8¼ mins. Consequently, it was in motion but 21¾ mins.—less than 25 per cent of the elapsed time. This point will be more forcibly presented later. The average speed while in motion was 6.98 miles per hour.

WEIGHT OF PAYING LOAD CARRIED IN LIGHT DELIVERY SERVICE.

Having now considered the nature of the work done in light delivery service, the next point to be taken up is the amount of work required of horses engaged in this class of service. Three factors enter into this determination. They are the load drawn, the distance covered and the speed at which the load is drawn through the distance. Each of these will be considered in turn.

The load drawn consists of the wagon, the driver, his assistant and the weight of the packages to be delivered.

The average weight of the driver may be taken as 150 pounds, that of his helper as 125 pounds. The weights of the wagons in this service for the same class of work are approximately alike—they average about 1300 pounds. That part of the weight caused by the packages carried is, of course, variable.

To determine the average weight of the "load" carried, the writer, through the kindness of several of the large department stores in the city, had the *heaviest "loads"* sent out from these stores for over three months weighed on a set of Fairbanks coal scales. Tables IV and V show the results obtained.

The average "load" on leaving the store, from Table IV, is 272.3 pounds. The average number of packages carried, 88.35. The average weight per package, 3.08 pounds.

In Tables IV and V the weights of the wagons "light" include in each case the weight of driver and assistant.

The data in Table IV. were obtained from wagons in the service of a house dealing in the lighter kinds of dry goods. It must be remembered in this connection that these figures were obtained from wagons selected on account of the unusual size or weight of their "load." The months which elapsed while the data in Tables IV and V were

TABLE IV.

Wgt. of wagon, "loaded." Lbs.	Wgt. of wagon, "light." Lbs.	Wgt. of "load." Lbs.	Number of packages.	Ave. weight, per package. Lbs.
1,750	1,590	160	129	1.24
1,840	1,590	250	82	3.04
1,930	1,590	350	172	2.04
1,850	1,590	260	131	1.98
1,860	1,590	270	106	2.54
1,750	1.510	240	57	4.21
1,700	1,500	200	63	3.2
1,620	1,440	180	90	2.00
1,620	1,440	180	58	3.1
1,830	1,520	310	144	3.1
1,710	1,570	140	80	1.75
1,680	1,500	180	117	1.54
1,700	1,500	200	126	1.58
2,100	1,790	310	33	9.39
2,200	1,790	410	51	8.04
2,120	1,790	330	51	6.47
2,150	1,790	360	69	5.21
2,130	1,790	340	65	5.23
2,370	1,790	580	64	9.06
2,600	1,790	810	77	10.39
1,710	1,500	210	137	1.53
1,720	1,500	220	132	1.66
1,610	1,500	110	108	1.01
1,660	1,500	160	120	1.33
1,660	1,500	160	116	1.38
1,660	1,500	160	119	1.35

being collected covered the period of heavy spring trade which occurs each year in this class of business, and therefore the tables may be considered as representing very closely the weight of "loads" started out with, in light delivery service.

Table V shows the weights carried by a store dealing in a much heavier class of merchandise than that represented in Table IV.

TABLE V.

Wgt. of wagon, "loaded." Lbs.	Wgt. of wagon, "light." Lbs.	Wgt. of "load." Lbs.	Number of packages.	Ave. weight, per package. Lbs.
2,030	1,660	370	85	4.35
1,960	1,660	300	65	4.61
2,270	1,660	610	160	3.81
2,230	1,660	570	135	4.22
1,975	1,660	315	112	2.81
2,110	1,660	450	110	4.09
2,060	1,415	645	150	4.3
2,180	1,415	765	146	5.24
1,830	1,415	415	113	3.67
1,860	1,415	445	132	3.37
2,290	1,680	610	140	4.36

The average load from Table V is found to be 499.54 pounds. The average number of packages is 122.5. The average weight per package, 4.1 pounds. The average "loads" found above—namely, 273.3 and 499.54 pounds—are the "loads" with which the wagon leaves the store. Consequently, the average "load" carried on any one trip is always much less. From the data given above it would seem as though the assumption of 300 pounds as being the average "load" carried on any one trip by wagons in light delivery service is a conservative one.

The fact is, it is not so much a question of weight-carrying capacity which enters into the consideration of the proper proportioning of units for light delivery service as of volume capacity. For the limitations which determine the size of single units are the number of packages that can be delivered per hour and the number of hours per day that it is found practical to keep the unit in operation with a satisfactory degree of efficiency.

It is evident from a consideration of Tables IV and V that the average weight per package seldom exceeds 4 pounds in this class of service; also that not infrequently 140 to 150 packages have to be distributed per trip. As was indicated in Table III, 20 deliveries per hour may be taken as exceptional—this will be more forcibly shown later. Hence, often over seven hours are required for the distribution of packages on one trip. As many units have to make three trips a day, it is evident that the weight of the load, under ordinary circumstances, can never be very large.

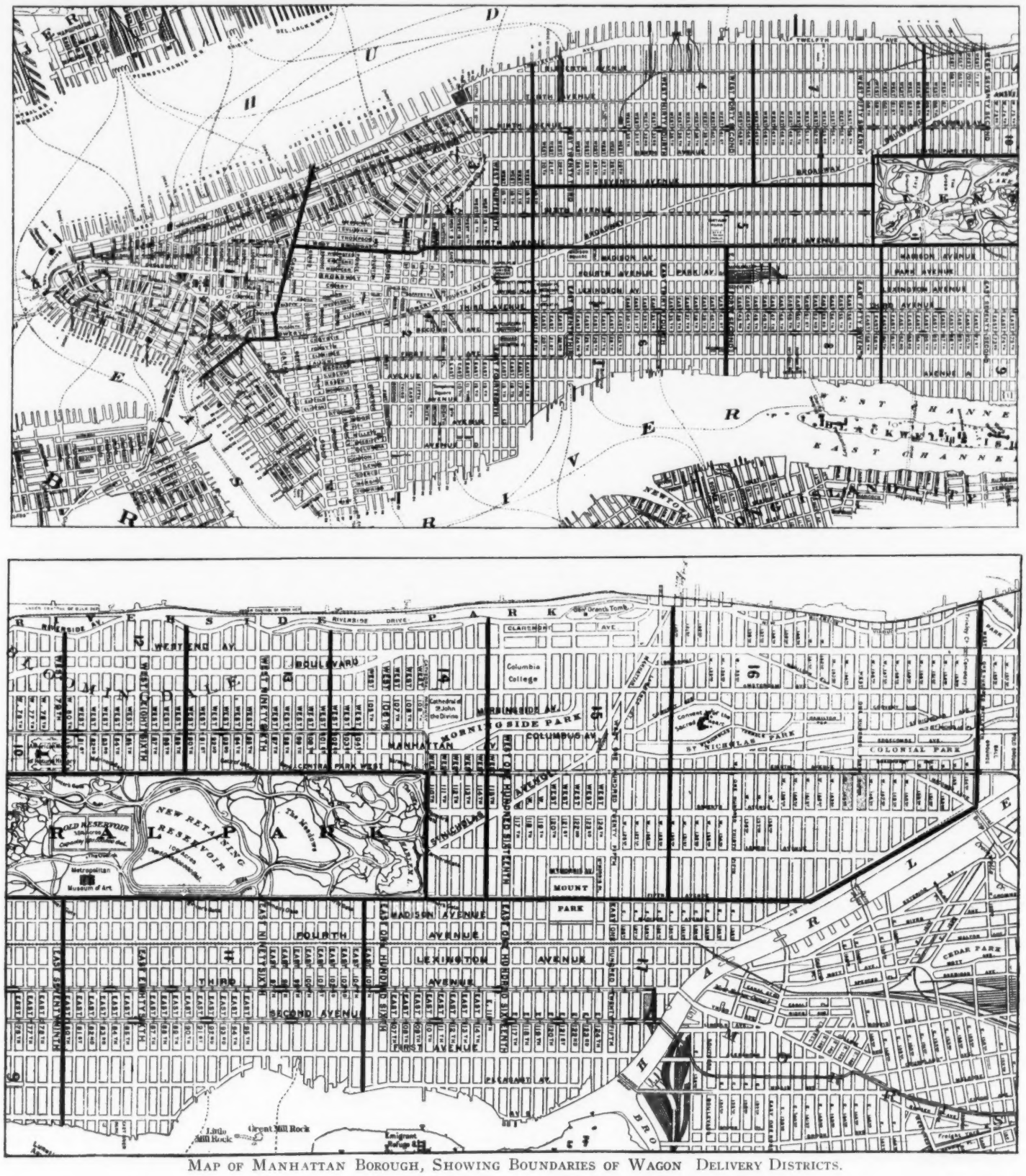
AVERAGE SPEED WHILE IN MOTION.

From that which has preceded, it follows that the weight which causes the draw-bar pull of a unit engaged in light delivery service seldom exceeds 1900 pounds. From tests made with a traction dynamometer on wagons of this class in the streets of New York, the writer has found that a draw-bar pull of 50 pounds per ton represents very closely the true average draw-bar pull exerted by horses attached to these wagons at a speed of 7 miles per hour. If this value is assumed to be the draw-bar pull for a 1900-pound unit, the assumption will favor the horse.

To determine as closely as possible the speed at which horses engaged in light delivery service travel while in motion, the writer, mounted on a bicycle, followed a large number of these vehicles under many varying conditions. The bicycle was equipped with a

tested tachometer. From these observations he has reached the definite conclusion that 7 miles per hour is the average rate of speed maintained while in motion by horses in light delivery service in New York City.

Having determined the pull exerted by the horse and the speed at which this pull is exerted, the remaining factor entering into the consideration of the amount of work done by these horses to be determined is the distance which they are required to travel per day.



MAP OF MANHATTAN BOROUGH, SHOWING BOUNDARIES OF WAGON DELIVERY DISTRICTS.

DISTANCES TRAVELED IN LIGHT DELIVERY SERVICE.

To determine this point, odometers were placed on the axles of wagons in the service of several of the large department stores in the city. These wagons were shifted from one to the other of the routes operated by these stores in the Borough of Manhattan. They were kept in regular delivery service in this manner for a period extending over three months. In this time the wagons under observation covered over 1700 miles. The results obtained are given in full in Tables VI, VIII, X and XII, as, it is thought, the data contained in them are of sufficient value to warrant their presentation in this extended form.

Column I, Table VI, gives the number of hours that one of the units was out of its stable during a trip. The second column gives the number of miles covered on the trip, and the figures in Column III correspond to those in Table I, which designate the number of the route and show over which route the wagon was traveling at the time the records in Columns I and II were obtained. A reference to the map of the Borough of Manhattan shown herewith will give at a glance the district in question—the numbers on the map corresponding to those in Column III.

Column IV. records the number of deliveries made per trip, while Column V shows the number of deliveries made per hour. This column gives the number per hour from the time the wagon left its stable until it returned to it again. The speed averaged by the wagon while out of the stable is given in Column VI. This speed, as will be noted, is very low. One of the reasons for this is that when the wagon leaves its stable, it proceeds at once to the store to receive its load. The time occupied in loading each vehicle varies—sometimes it is only a few minutes; at others an hour or more may pass before a wagon is ready to start on its trip. Also the time the wagon is at rest while out on its route is included in this column. In Column VII the time the horse was in motion during a trip is approximated. In figuring the results for this column, 7 miles an hour was taken as the average speed of the horse while in motion. Column VIII follows directly from the last preceding.

A study of Table VI shows that, of the 81 trips recorded in it, but 4 exceeded 20 miles in length. These 4 are reproduced in Table VII for ease of comparison with the values given in Table XI. It may be well to remark here that, in collecting the data presented in Table VI, each unit district shown in the map was covered at least twice, while those districts in which the horse may be expected to do the most work were covered at least four times.

TABLE VI.

Time wagon was out of its stable on one trip.	Number of miles traveled during the trip.	City district covered on the trip.	Number of deliveries made on the trip.	Number of deliveries made per hour on the trip from stable to stable.	Speed in miles per hour that wagon averaged on the trip.	Average time wagon was in motion on the trip, approximated.	Average time wagon was at rest on the trip, approximated.
h. m.						h. m.	h. m.
3 02	8.075	I.	14	4.61	2.66	1 09	1 53
2 25	8.875		20	8.2	3.70	1 16	1 09
3 30	9.376	II.	28	8.0	2.68	1 20	2 10
3 55	10.325		35	8.9	2.63	1 28	2 27
2 15	6.700		25	11.1	2.97	0 58	1 17
4 45	13.125		42	8.8	2.10	1 53	2 52
3 50	8.250		48	12.5	2.10	1 11	2 39
1 45	5.450		21	12.0	3.11	0 46	0 59
3 25	9.225	III.	38	11.1	2.70	1 19	2 06
3 20	7.975		44	13.2	2.39	1 08	2 12
2 36	5.50	V.	68	26.0	2.11	0 47	1 49
3 42	6.85		55	15.0	1.85	0 59	2 43
3 45	8.75		49	13.0	2.33	1 15	2 30
2 40	2.80		60	22.6	1.05	0 24	2 16
2 53	7.50		64	22.1	2.60	1 04	1 49
3 35	10.10	IV.	63	17.5	2.81	1 27	2 08
3 40	8.60		68	18.6	2.35	1 14	2 26
3 35	7.80		71	19.8	2.18	1 07	2 28
2 19	7.15		50	21.5	3.08	1 02	1 17
3 40	10.35	VI.	73	19.9	2.82	1 29	2 11
2 43	8.775	VII.	40	14.7	3.23	1 16	1 27
3 07	8.750		58	18.61	2.80	1 15	1 52
3 20	9.475		51	15.3	2.84	1 22	1 58
3 15	8.775		51	15.8	2.62	1 15	2 00
3 05	7.420		65	21.1	2.40	1 04	2 01
2 42	8.500	VIII.	36	13.3	3.14	1 13	1 29
4 20	8.400		72	16.6	1.94	1 12	3 08
4 00	7.875		32	8.0	1.97	1 08	2 52
3 00	7.175		70	23.3	2.39	1 02	1 58
3 25	9.800		69	20.1	2.87	1 24	2 01
4 30	9.500		49	10.8	2.11	1 22	3 08
3 15	8.900		78	24.0	2.73	1 17	1 58
6 33	13.475	X.	123	18.7	2.06	1 56	4 37
2 25	9.375		34	14.1	3.88	1 21	1 04
4 15	17.875		81	19.0	4.20	2 34	1 41
3 40	11.375	IX.	44	12.0	3.10	1 38	2 02
3 45	10.450		54	14.4	2.78	1 30	2 15
3 00	7.875		45	15.0	2.62	1 08	1 52
4 50	12.525	XII.	80	16.5	2.59	1 48	3 02
2 40	7.650		54	20.3	2.87	1 06	1 34
4 05	11.975		78	19.1	2.93	1 43	2 22
4 30	15.500		86	19.1	3.44	2 13	2 17
5 55	15.775	XI.	74	12.6	2.66	2 16	3 39
4 30	13.875		58	12.9	3.08	1 59	2 31
5 00	12.150	XIII.	56	11.2	2.43	1 45	3 15
4 10	12.775		83	19.9	3.06	1 50	2 20
8 20	...		158	18.9	...	...	...
3 35	10.100		60	16.7	2.81	1 27	2 08
6 25	12.950		105	16.3	2.01	1 51	4 34
3 45	11.350		65	17.3	3.02	1 38	2 07
6 40	12.200		87	13.0	1.83	1 45	4 55
5 10	13.600		59	11.4	2.63	1 57	3 13
5 25	10.450		48	8.86	1.92	1 30	3 55
4 10	17.425		58	13.9	4.18	2 30	1 40
8 10	21.500		160	19.6	2.63	3 05	5 05
5 55	17.475	XIV.	87	14.7	2.95	2 30	3 25
5 15	21.000		43	8.19	4.00	3 00	2 15
3 45	10.375		59	15.7	2.76	1 29	2 16
8 55	18.220		212	23.7	2.49	2 37	6 18
4 30	9.175		59	13.1	2.04	1 19	3 11
8 30	12.825		160	18.8	1.50	1 50	6 40
5 05	14.625		63	12.3	2.87	2 06	2 59
8 00	14.875		163	20.38	1.86	2 08	5 52
4 35	13.075		63	13.7	2.85	1 53	2 42
7 00	21.325	XV.	62	8.85	3.05	3 03	3 57
4 00	18.175		23	5.75	4.54	2 36	1 24
6 40	17.600		84	12.61	2.64	2 31	4 09
4 00	15.775		34	8.5	3.94	2 16	1 44
6 35	14.125		62	9.4	2.10	2 02	4 33
...	13.350		48	...	...	...	...
6 25	13.975		53	8.26	2.17	2 00	4 25
4 05	14.650		60	14.6	3.58	2 06	1 59
6 20	19.650	XVII.	45	7.1	3.10	2 49	3 31
3 35	18.650		17	4.7	5.20	2 40	0 55
7 15	20.225		79	10.2	2.78	2 54	4 21
3 50	13.800		40	10.4	3.60	1 59	1 51
9 20	19.875		163	17.4	2.13	2 51	6 29
3 25	18.875		45	10.2	5.52	2 42	0 43
6 10	17.400	XVI.	69	11.1	2.82	2 30	3 40
4 45	17.850		49	10.3	3.75	2 33	2 12
5 05	16.700		33	6.49	3.28	2 24	2 41
5 15	13.975		56	10.6	2.66	2 00	3 15
5 00	...		48	9.6	...	...	...

TABLE VII.

Time wagon was out of stable on one trip.	Number of miles traveled during one trip.	Unit district covered on trip.	Number of deliveries made on trip.	Number of deliveries made per hr. on trip, stable to stable.	Speed in miles per hr. averaged by wagon on trip.	Average time wagon was in motion on trip—approximated.	Average time wagon was at rest on trip—approximated.
h. m.						h. m.	h. m.
7 15	20.225	17	79	10.2	2.78	2 54	4 21
5 15	21	14	43	8.19	4.00	3 00	2 15
7 00	21.325	15	62	8.85	3.05	3 03	3 57
8 10	21.5	13	160	19.6	2.63	3 05	5 05

In Table VII the longest distance recorded is 21.5 miles. This was the greatest distance traveled in regular delivery service on one trip by any of the wagons under observation, and as the period of observation extended over three months and included one of the busiest periods of the year in this class of business, it is fair to assume that this trip represents very closely the maximum distance ever required of one horse in light delivery service in the Borough of Manhattan. The time consumed on this trip was 8 hrs. 10 mins., and in that time 160 packages were delivered. This wagon, as soon as it returned to the stable, changed horses and went out again immediately to cover the same route. The time occupied on this second trip was 4 hrs. 25 mins., and 95 packages were delivered in that period. The time the wagon was out of the stable that day was, therefore, 12 hrs. 35 mins., and 255 packages were delivered. The rate of delivery per hour was 20.26 packages for the day, which is a much higher rate than is shown to be usual in Column V, Table VI. The average of 82 readings in this column gives 12.96 packages per hour as a more usual rate. Only 10 of the 82 readings show a rate of delivery of over 20 packages per hour. The maximum is 26 packages per hour, and this was accomplished in a district adjoining the store, and on the trip the horse covered but 5.5 miles, while the time he was out of the stable was but 2 hrs. 36 mins.

From the above it would seem as though 22 miles a day might be taken as the maximum distance required of horses on one trip in the Borough of Manhattan. That a horse could keep this rate up, day in and day out, the year round, of course, as is well known, is practically impossible.

The average distance required of these horses on one trip is shown in Table VI to be but 12.05 miles. The average time consumed per trip to be but 4 hrs. 30 mins. Of this but 1 hr. 45 mins. represents the average time spent in motion, the remainder—2 hrs. 45 mins.—being the average time at rest. Thus, on an average, over 60 per cent of the time spent by the horse out of his stable is time spent at rest.

The average of 80 readings shows 2.82 miles per hour to be the average speed of the wagon from the time it leaves the stable until it returns to it again. The average number of packages carried per trip is 62.8.

Table VI, it must be remembered, records the result of 82 single trips. In Table VIII the record per day for the same period and stable is given.

Column I, Table VIII shows the number of miles traveled per day by each horse under observation. The average of the 62 readings shows 14.46 miles to be the usual distance required per horse per day. The maximum reading obtained was 26.475 miles traveled by a horse in one day. This horse was out on route No. 12 that day. He went over the route once in the morning and once in the afternoon. In the morning he was out 4 hrs. 5 mins., and covered 11.97 miles. In the afternoon he was out 4 hrs. 30 mins. and covered 15.5 miles. He was at rest in his stall, between trips, 6 hrs. 15 mins., however, and the next day made but one trip. This 26.475-mile journey in one day cannot, therefore, be looked upon as being quite as severe a day's work as the 21.5-mile single trip noted above.

In Column II the number of miles traveled per day by the wagon is

recorded. The average of 31 readings gives 28.21 miles as the usual distance averaged per day by a wagon. The maximum distance any of the wagons under observation traveled was 39.5 miles. On this day the route was No. 15 and the horse which had the morning trip covered 21.325 miles; the one on the afternoon trip 18.175 miles. The time the wagon was in motion exceeded the time it was at rest. This is accounted for by the few packages carried on both trips. The tendency when only a few packages are to be delivered is for the driver to make a door-to-door delivery and not resort to "back loading." This increases the distance traveled by the wagon.

The average number of hours the horse is out of his stable per day is given, for 62 readings, as 5 hrs. 18 mins. The average number of

TABLE VIII.

Number of miles one horse traveled per day.	Number of miles one wagon traveled per day.	Number of hours one horse was out of stable per day.	Number of hours one wagon was out of stable per day.	Speed in miles per hour that wagon averaged per day.	Time wagon was in motion during day, approximated.	Time wagon was at rest during day while out of stable, approximated.
		h. m.	h. m.		h. m.	h. m.
9.225	22.8	3 25	9 03	2.51	3 16	5 47
13.575		5 38				
10.325	26.4	3 55	9 40	2.73	3 47	5 53
16.075		5 45				
13.475	22.85	6 33	8 58	2.54	3 16	5 42
9.375		2 25				
8.775	25.025	2 43	8 32	2.93	3 35	4 57
17.250		5 49				
17.875	32.825	4 15	10 09	3.23	4 42	5 27
14.950		5 54				
8.750	23.1	3 45	10 20	2.23	3 18	7 02
14.350		6 35				
12.150	24.925	5 00	9 10	2.72	3 34	5 36
12.775		4 10				
21.325	39.5	7 00	11 00	3.59	5 39	5 21
18.175		4 00				
10.450	28.675	3 45	10 25	2.75	4 06	6 19
18.225		6 40				
15.775	29.65	5 55	10 25	2.84	4 15	6 10
13.875		4 30				
19.650	38.30	6 20	9 55	3.86	5 29	4 26
18.650		3 35				
7.975	19.65	3 20	8 25	2.33	2 50	5 35
11.675		5 05				
8.250	26.825	3 50	10 20	2.59	3 50	6 30
18.575		6 30				
8.775	25.67	3 15	9 40	2.65	3 40	6 00
16.895		6 25				
10.100	30.275	3 35	11 05	2.73	4 20	6 45
20.175		7 30				
21.000	31.375	5 15	9 00	3.49	4 29	4 31
10.375		3 45				
8.600	35.075	3 40	12 15	2.04	5 01	7 14
26.475		8 35				
7.875	23.45	4 00	11 20	2.07	3 21	7 59
15.575		7 20				
9.500	27.67	4 30	11 10	2.47	3 58	7 12
18.170		6 40				
17.400	35.25	6 10	10 55	3.22	5 03	5 52
17.850		4 45				
16.700	30.675	5 05	10 20	2.96	4 23	5 57
13.975		5 15				
17.600	33.375	6 40	10 40	3.13	4 46	5 54
15.775		4 00				
13.975	28.625	6 25	10 30	2.73	4 06	6 24
14.650		4 05				
18.220	27.395	8 55	13 25	2.04	3 55	9 30
9.175		4 30				
12.825	27.45	8 30	13 35	2.02	3 56	9 39
14.625		5 05				
14.875	27.95	8 00	12 35	2.22	4 00	8 35
13.075		4 35				
12.950	24.30	6 25	10 10	2.39	3 29	6 41
11.350		3 45				
12.200	25.8	6 40	11 50	2.18	3 42	8 08
13.600		5 10				
10.450	27.875	5 25	9 35	2.90	3 59	5 36
17.425		4 10				
20.225	34.02	7 15	11 05	3.06	4 52	6 13
13.800		3 50				
19.875	38.75	9 20	12 45	3.04	5 33	7 12
18.875		3 25				

hours the wagon is out of the stable per day for 31 readings is given as 10 hrs. 35 mins. The number of miles per hour traveled by the wagon per day for 31 readings is 2.74 miles. The maximum average speed of a wagon per day noted is 3.86.

The average time the wagon is in motion per day from 31 readings is 4 hrs. 8 mins. The time at rest 6 hrs. 27 mins.—over 60 per cent of the time out of the stable. Only 2 out of 31 observations show cases where the wagon was in motion during the day longer than it was at rest. One of these shows but 18 mins. difference; the other 1 hr. 30 mins. This last case is the one where the maximum average speed of the wagon per day noted above was recorded.

The longest time any one of the wagons was at rest was 9 hrs. 39 mins. This wagon was out 13 hrs. 35 mins., therefore it was at rest over 71 per cent of the time it was away from the stable that day.

Of the 83 readings recorded in Table VI, but 32 were taken in the eight districts the upper boundaries of which are Sixty-fifth Street on the west and Sixtieth Street on the east. The remaining 51 readings were obtained, on the other hand, in the nine districts situated above Sixtieth Street on the east and Sixty-fifth Street on the west. Of these 51 readings 39 are for the four districts above Ninety-first Street on the west and 105th Street on the east. Thus over 62 per cent of the readings were obtained in districts lying at a considerable distance from the store, while over 76 per cent of the latter readings are for districts above Ninety-first Street on the west and 105th Street on the east. Hence, when considering the Borough of Manhattan as a whole, the averages obtained from Tables VI and VIII may be taken as conservative. These averages, as noted above, have been collected and are presented in Table X. The first column of this table gives the number of observations from which the averages found in Column III were obtained. The centre column explains the values in the last.

TABLE IX.

Number of readings.		Averages from Tables VI and VIII.
83	Number of packages carried per trip	62.8
82	Number of packages delivered per hour	12.96
81	Miles traveled per trip	12.05
62	Miles traveled per day per horse	14.46
31	Miles traveled per day per wagon	28.21
82	Time horse is out of stable per trip	4 hrs. 30 mins.
62	Time horse is out of stable per day	5 hrs. 18 mins.
31	Time wagon is out of stable per day	10 hrs. 35 mins.
80	Hours wagon is in motion per trip	1 hr. 45 mins.
80	Hours wagon is at rest per trip	2 hrs. 45 mins.
31	Hours wagon is in motion per day	4 hrs. 8 mins.
31	Hours wagon is at rest per day	6 hrs. 27 mins.
80	Speed in miles per hour per trip	2.821
31	Speed in miles per hour per day	2.74

The results shown in Table IX were obtained, as has been explained, from a store requiring more than the average work of its horses. To demonstrate this fact the results obtained while investigating the delivery service of one of the other stores are presented in Tables X and XII. The delivery department of this store is called upon to handle a large percentage of C. O. D. goods. This form of delivery requires much more time than is necessary when delivering goods that have been charged. Also the unit districts in the Borough of Manhattan operated by this store are more numerous than those operated by the store already considered in the same territory; the number of unit districts being 33, as against the 17 shown in Table I.

The average of the 84 readings in Column II of Table X is 10.07 miles per trip. Only three of these show distances covered of over 20 miles on a trip. These three are reproduced in Table XI for ease of reference with the values given in Table VII.

EFFECT OF C. O. D. PACKAGES ON THE DELIVERY.

A comparison of Tables VII and XI shows plainly the effect of C. O. D. packages on the length of time consumed in delivery. The difference shown in the two tables for the speed in miles per hour also shows this.

The 25.725-mile trip recorded in Table XI was made the Saturday before Easter Sunday last, and was devoted to the delivery of Easter flowers that had been specially promised by the store. The delivery district, as indicated in Column III, included, for this trip, all the territory lying between Sixteenth Street and 136th Street, east and west from river to river. That this trip should have covered 25.725 miles is not to be wondered at, but it cannot be considered as representative of the average requirements in this class of delivery service. The other two trips recorded in this table, however, represent deliveries over regular routes, and it is instructive to note that though practically the same time was spent in motion by the horses of both stores, as shown in Tables VII and XI, the time spent at rest for approximately the same number of deliveries was very much greater in the one case than in the other. The average of the 84 readings of Column I, Table X, is 5 hrs. 21 mins., as against 4 hrs. 30 mins. as shown in Table IX for 82 readings. A comparison of the average of the 84 readings of the remaining six columns of Table X with the corresponding averages from Table IX shows the following:

Table IX.		Table X.
62.8	....Number of packages carried per trip....	61.7
12.96	...Number of packages delivered per hour...	11,15
12.05	.....Miles traveled per trip.....	10.07
1 hr. 45 mins.	.....Hours wagon is in motion per trip.....	1 hr. 27 mins.
2 hrs. 45 mins.	.....Hours wagon is at rest per trip.....	3 hrs. 54 mins.
2.821	.....Speed in miles per hour per trip.....	1.98

A study of this comparison shows that the horses engaged in the service of the store represented in Table IX cover more miles per

trip and are in motion longer and at rest a shorter time than the horses of the store represented in Table X. Also that the number of packages carried per trip is greater, as well as the number of deliveries per hour. Therefore the horses of the store represented in Table IX, which are those belonging to the stable that has been selected as a standard, do more work than those of the other store. The difference in amount of work done is even more noticeable from a consideration of Table XII.

This table corresponds to Table VIII and shows the miles, etc., per day per wagon for the store represented in Table X. The average of the 64 readings in Columns I and III, Table XII, giving 12.838 miles as the number of miles traveled per day per horse, as against

TABLE X.

Time wagon was out of stable on one delivery trip.	Number of miles traveled during one trip.	Speed in miles per hour that wagon averaged on one trip.	Number of deliveries made on one trip.	Number of deliveries made per hr. on one trip, stable to stable.	Average time wagon was in motion on one trip—approximated.	Average time wagon was at rest on one trip—approximated.
h. m.					h. m.	h. m.
2 00	3.250	1.63	9	4.50	0 28	1 32
3 00	3.700	1.23	35	11.66	0 32	2 28
3 20	4.225	1.26	44	13.20	0 37	2 43
3 50	4.600	1.2	69	18.00	0 46	3 10
3 00	4.600	1.53	27	9.00	0 40	2 20
3 55	4.675	1.19	49	12.50	0 41	3 14
3 30	4.900	1.4	62	17.70	0 42	2 48
3 35	5.050	1.4	49	13.70	0 44	2 51
4 05	5.300	1.3	56	13.70	0 46	3 19
2 40	5.375	2.01	48	18.00	0 47	1 53
3 05	5.425	1.75	32	10.30	0 47	2 18
3 00	5.550	1.85	42	14.00	0 48	2 12
3 10	5.575	1.76	45	14.20	0 48	2 22
3 25	5.600	1.64	61	17.90	0 48	2 37
3 10	5.625	1.77	51	16.10	0 49	2 21
2 25	5.650	2.33	20	8.30	0 49	1 36
2 00	5.750	2.87	14	7.00	0 50	1 10
3 25	5.800	1.69	67	19.60	0 50	2 35
3 25	5.825	1.7	40	11.70	0 50	2 35
2 45	5.975	2.17	33	12.00	0 52	1 53
5 00	6.400	1.28	70	14.00	0 55	4 05
2 15	6.425	2.85	14	6.22	0 56	1 19
2 40	6.575	2.46	22	8.20	0 57	1 43
3 35	6.850	1.9	35	9.7	0 59	2 36
3 45	6.875	1.83	60	16.00	0 59	2 46
4 05	7.200	1.76	41	10.00	1 02	3 03
5 45	7.375	1.28	25	4.35	1 04	4 41
3 25	7.500	2.2	29	8.40	1 05	2 20
2 20	7.500	3.21	18	7.70	1 05	1 15
3 50	7.550	1.96	20	5.21	1 05	2 45
9 00	7.650	0.85	137	15.20	1 06	7 54
4 20	7.650	1.76	68	15.69	1 56	2 24
4 10	**7.650**	**1.84**	44	10.60	1 06	3 04
3 15	7.725	2.37	20	6.10	1 07	2 08
6 45	7.725	1.14	53	7.8	1 07	5 38
5 10	7.750	1.5	99	19.00	1 07	3 63
3 20	7.850	2.35	32	9.60	1 08	2 12
4 40	8.125	1.74	70	15.00	1 10	3 30
3 35	8.250	2.3	26	7.20	1 11	2 24
5 20	8.450	1.58	63	11.8	1 13	4 07
5 20	8.625	1.61	46	8.6	1 14	4 06
4 30	8.750	1.94	22	5.00	1 15	3 15
5 30	8.775	1.59	51	9.27	1 16	4 14
4 30	8.875	1.97	40	8.8	1 17	3 13
6 25	8.950	1.39	53	8.20	1 17	5 08
5 35	9.000	1.61	48	8.6	1 18	4 17
4 10	9.125	2.19	49	11.70	1 19	2 51
3 25	9.150	2.67	25	7.30	1 19	2 06
3 25	9.200	2.69	12	3.51	1 19	2 06
5 15	9.250	1.77	48	9.1	1 20	3 55
6 00	9.525	1.59	56	9.3	1 22	4 38
2 50	9.650	3.4	19	6.07	1 23	1 27
4 55	9.775	1.98	69	14.00	1 24	3 31
3 15	9.850	3.03	24	7.30	1 25	1 50
6 25	10.100	1.57	73	11.3	1 27	4 58
7 55	10.175	1.29	113	14.27	1 28	6 27
2 50	10.250	3.6	11	3.8	1 28	1 22
6 10	10.475	1.69	60	9.7	1 30	4 40
6 20	11.100	1.75	63	9.94	1 36	4 44
5 35	11.750	2.1	75	13.4	1 41	3 54
12 05	11.900	0.984	213	17.6	1 42	10 23
6 00	14.125	2.35	47	7.83	2 02	3 58
7 05	14.725	2.06	103	14.50	2 07	4 58
7 55	15.025	1.88	97	12.2	2 09	5 46
6 00	15.125	2.52	68	11.30	2 10	3 50
4 40	15.250	3.27	68	14.6	2 11	2 29
6 00	15.325	2.55	60	10.	2 12	3 58
9 55	15.625	1.57	133	13.4	2 14	7 41
4 35	15.700	3.64	18	3.92	2 15	2 20
7 55	15.950	2.01	100	12.6	2 17	5 38
12 10	16.000	1.31	161	13.2	2 17	9 53
8 25	16.025	1.9	108	12.8	2 18	6 07
8 40	16.350	1.88	97	11.2	2 21	6 19
7 25	16.425	2.21	79	10.6	2 21	5 04
8 05	16.675	2.06	127	15.7	2 23	5 42
11 40	16.775	1.43	183	15.7	2 24	9 16
4 50	17.300	3.58	69	14.2	2 29	2 21
7 05	17.500	2.46	73	10.30	2 30	4 35
10 50	18.000	1.66	115	10.6	2 35	8 15
4 40	18.125	3.88	53	11.3	2 36	2 04
9 20	18.250	1.95	104	11.14	2 37	6 43
12 25	20.275	1.63	144	11.6	2 54	9 31
11 30	21.200	1.84	151	13.1	3 02	8 28
10 55	25.725	2.35	81	7.42	3 41	7 14

TABLE XI.

Time wagon was out of stable on one trip.	Number of miles traveled during one trip.	Unit district covered on trip.	No. of deliveries made on trip.	No. of deliveries made per hr. on trip, stable to stable.	Speed, miles per hr., averaged by wagon on trip.	Ave. time wagon was in motion on trip, approx.	Ave. time wagon was at rest on trip, approx.
h. m.						h. m.	h. m.
12 25	20.275	66th St. to 99th St. East of 3d Ave.	144	11.6	1.63	2 54	9 31
11 30	21.2	100th St. to 136th St. 4th Ave. to River.	151	13.1	1.84	3 02	8 28
10 55	25.725	116th St. to 136th St. East and west, special.	81	7.42	2.35	3 41	7 14

TABLE XII.

Number of miles one horse traveled per day.	Number of hrs. one horse was out of stable per day.	Number of miles one horse traveled per day.	Number of hrs. one horse was out of stable per day.	Number of miles one wagon traveled per day.	Number of hours one wagon was out of stable per day.	Speed in miles per hr. that wagon averaged per day.	Time wagon was in motion during day—approximated.	Time wagon was at rest during day while out of stable—approximated.
	h. m.		h. m.		h. m.		h. m.	h. m.
4.675	3 55	14.600	7 00	11.9	12 05	.98	1 42	10 23
6.850	3 25	14.725	7 05	15.175	10 50	1.40	2 11	8 39
7.650	9 00	14.125	6 00	13.40	11 00	1.22	1 55	9 05
7.750	5 10	15.475	6 15	15.125	10 55	1.38	2 10	8 45
7.375	5 45	15.675	5 55	16.	12 10	1.31	2 18	9 52
7.650	4 20	15.125	6 00	16.775	11 40	1.43	2 24	9 16
6.400	5 00	15.625	9 55	17.775	9 35	1.85	2 33	7 02
7.720	6 45	15.700	4 35	17.25	10 50	1.59	2 28	8 22
8.250	3 25	15.950	7 55	17.5	10 50	1.61	2 30	8 20
8.125	4 40	15.325	6 00	18.	10 50	1.66	2 35	8 15
8.450	5 20	15.025	7 55	19.65	10 55	1.80	2 57	7 58
8.950	6 25	15.250	4 40	19.95	12 50	1.55	2 51	11 59
8.775	5 30	16.975	7 30	19.425	11 50	1.64	2 47	9 03
8.875	4 30	16.650	6 50	19.6	12 10	1.61	2 48	9 22
9.525	6 00	16.275	5 30	20.275	12 25	1.63	2 54	9 31
9.000	5 35	16.425	7 25	21.2	11 30	1.84	3 02	8 28
9.800	6 30	16.775	11 40	21.275	12 30	1.70	3 03	9 27
9.250	5 15	16.675	8 05	22.35	12 55	1.73	3 12	9 43
9.775	4 55	16.000	12 10	22.85	11 45	1.94	3 16	8 29
9.200	3 25	16.350	8 40	23.35	10 45	2.17	3 21	7 24
9.225	4 45	16.025	8 25	23.05	12 20	1.06	3 18	8 52
10.475	6 10	17.300	4 50	23.4	12 40	1.84	3 21	9 19
10.400	7 15	17.500	7 05	23.35	13 20	1.90	3 21	9 59
10.600	6 35	18.000	10 50	24.	13 10	1.82	3 26	9 44
10.100	6 25	18.125	4 40	25.75	11 40	2.20	3 41	7 59
10.500	6 55	18.250	9 20	25.425	12 20	2.06	3 38	8 42
10.175	7 55	20.275	12 25	25.575	12 10	2.10	3 40	8 30
10.175	6 10	21.200	11 30	25.85	12 00	2.15	3 42	8 18
11.875	6 45	25.725	10 55	28.025	11 05	2.52	4 01	7 04
11.750	5 35			30.275	12 35	2.40	4 20	8 15
11.900	12 05			31.325	14 30	2.16	4 29	10 01
11.100	6 20			32.625	13 05	2.49	4 40	8 25
13.025	6 50			33.725	12 15	2.75	4 50	7 25
14.400	6 55			34.475	13 20	2.58	4 56	8 24
14.750	7 55			34.925	14 20	2.43	4 59	9 21

14.46 miles shown in Table IX. A comparison of the average of the 35 readings in the other columns of Table XII with the corresponding values in Table IX shows the following:

Table IX.		Table XII.
28.21	.....Miles traveled per day per wagon.....	22.57
10 hrs. 35 mins.	....Time wagon is out of stable per day....	12 hrs. 2 mins.
4 hrs. 8 mins.	.....Hours wagon is in motion per day.....	3 hrs. 15 mins.
6 hrs. 27 mins.	.....Hours wagon is at rest per day.....	8 hrs. 51 mins.
2.74	.....Speed in miles per hour per day.....	1.56

The number of hours one horse is out of his stable per day from 64 readings, Columns II and IV, Table XII, is 6 hrs. 50 mins., as against 5 hrs. 18 mins. for 62 readings, as shown in Table IX.

This comparison shows that the wagons engaged in the service of the store represented in Table IX cover more miles per day and are in motion longer per day and at rest a shorter time than the wagons of the store represented in Table XII. Thus again it is demonstrated that the horses in the stable selected for comparative purposes are actually doing more work than those engaged in the same class of service in other stores.

So far the time has been considered from the moment the horses and wagons left the stable until they returned to it. To determine the change which takes place, if any, in the results when the time is considered from the moment the horses and wagons leave the store until their return to the stable, Table XIII was compiled. (Page 605.)

A comparison of the average of the 16 readings for several columns of Table XIII with the corresponding values in Table X shows the following:

Table XIII.		Table X.
2.4	.....Speed in miles per hour per trip.....	1.98
16.8	.....Number of packages delivered per hour.....	11.15
63%	.....Percentage of time at rest to total of elapsed time.....	72.8%

From the above it is evident that the time at rest is shortened and the rate of delivery increased; also the speed in miles per hour. The general result, however, is unchanged.

WORK DONE BY HORSES IN LIGHT DELIVERY SERVICE.

Having now determined approximately the "load" drawn, the speed sustained while in motion and the average distance traveled over by the horses engaged in light delivery service, the average work done by a horse per day in this service may be approximated. From that which

TABLE XIII.

Time wagon was gone from store to stable.	Miles traveled.	Number of deliveries.	Miles per hour wagon averaged.	Number of deliveries per hr.	Time wagon was in motion, approximated.	Time wagon was at rest, approximated.
h. m.					h. m.	h. m.
2 50	5.300	56	1.16	19.7	0 46	2 04
2 40	4.600	69	1.72	25.8	0 40	2 00
2 45	5.050	49	1.83	17.8	0 44	2 01
2 30	5.625	51	2.25	20.4	0 49	1 41
1 40	5.375	48	3.22	28.8	0 47	0 53
3 40	9.125	49	2.48	13.4	1 19	2 21
2 35	5.825	40	2.26	15.4	0 50	1 45
2 30	7.500	29	3.00	11.6	1 05	1 25
2 00	5.650	20	2.83	10.0	0 49	1 11
2 25	5.425	32	2.24	13.2	0 47	1 38
3 25	7.200	41	2.10	12.0	1 02	2 23
3 00	6.875	60	2.29	20.0	0 59	1 01
1 30	6.425	14	4.28	9.3	0 56	0 34
2 30	4.900	62	1.96	24.8	0 42	1 48
2 20	5.575	45	2.39	19.2	0 48	1 32
1 15	3.250	9	2.60	7.2	0 28	0 47

has preceded, if we assume 16.5 miles a day, six days in a week as the average distance covered by each horse in light delivery service in the Borough of Manhattan, this assumption would seem to favor the horse.

Taking 16.5 miles as the average distance traveled, 50 pounds as the average pull exerted, and 7 miles per hour as the average speed sustained while in motion, a horse does 4,356,000 foot-pounds of work a day. This is at the rate of 30,800 foot-pounds per minute, or the horse is exerting .93 of a theoretical horse-power for 2 hrs. 22 mins. per day. It must be remembered in this connection that the horse is working at a speed of 7 miles per hour.

THE COST OF LIGHT DELIVERY SERVICE.

The nature and average amount of work required in light horse delivery service having been considered, it remains to determine the cost of this service. In Table XIV the cost of maintaining a unit per year to the stable selected as showing practically the lowest figures procurable in the Borough of Manhattan is given.

TABLE XIV.

Cost per year for one wagon, two horses, a driver and delivery boy—a unit—to a stable maintaining twenty vehicles and forty horses, engaged in light delivery service in the Borough of Manhattan, New York City.

Interest on first cost of two horses at 6 per cent per annum (First cost, $150 per horse.)	$18.00
Depreciation of two horses per year (Average life of horse 5 years—worth then $50.)	40.00
Interest on first cost of wagon at 6 per cent per annum (First cost of wagon, $350.)	21.00
Depreciation of wagon per year (Average useful period, 7 years.)	50.00
Interest on first cost of harness at 6 per cent per annum (First cost of harness, $55.)	3.30
Depreciation of harness per year (Average useful period, 5 years.)	11.00
Cost of blankets for two horses per year	14.00
Repairs to harness per year (average)	10.95
Repairs to wagon per year (average)	90.00
Cost of food and bedding for two horses per year	240.90
Cost of attendance on two horses per year	143.00
Cost of shoeing two horses per year	48.00
Stable rent chargeable to one wagon per year	37.50
Stable rent chargeable to two horses per year	112.50
Cost of attendance on one wagon per year	28.60
Insurance on stable chargeable to one wagon per year	1.08
Insurance on stable chargeable to two horses per year	3.24
Cost of having refuse removed for two horses per year	6.25
Veterinary bill for two horses per year (average)	7.50
Salary of driver per year	624.00
Salary of boy per year	208.00
Cost to stable per year for one wagon, two horses, driver and boy	$1,718.82
Cost to stable per day for one wagon, two horses, a driver and boy	$4.7090

Table XIV shows the cost per day per unit to be $4.709. This does not include gas, water tax, taxes, repairs to stable, etc., all of which, it has been assumed, would be common to and of equal amount for both electric and horse systems. That this is not strictly true is evident when we consider that the iron-shod hoofs of the horse on the floors and runways leading to the stalls from the wagon floor, including the wear and tear on the stalls, will cause a higher rate of depreciation and a greater cost for repairs than the action of the rubber-tired wheels of the electric vehicles could possibly cause on the wagon floor. Leaving out these items is, therefore, a point in favor of the horse when making a comparison.

Taking the "load" on leaving the store as 600 pounds, the average weight of the unit on a trip, including the average "load," as 1900 pounds, the average distance traveled per day by a wagon as 33 miles—16.5 miles per day averaged per horse—the ton-miles per day will be 31.35 per unit. Therefore, the cost per ton-mile under this supposition is 15.02c.; the cost per car-mile 14.27c.; the cost per pound of delivery per mile .04756c.; the cost per pound of total delivery per day .26161c.—three deliveries a day of 600 pounds each on leaving the store, or 1800 pounds of delivery a day.

That this supposition is a conservative one and that the figures given favor the horse system, it is thought the data already presented clearly demonstrates. To illustrate this point more forcibly, however, the case will now be considered where the average values actually found from the tables are used.

From Table VIII the average distance traveled per day per wagon was found to 28.21 miles. The average weight of "load" on leaving the store may be taken from Table IV to be 300 pounds. The cost per unit per day the same as before.

The average weight of a unit on a trip is, under this supposition, 1725 pounds; the ton-miles accomplished per day are 24.33; the cost per ton-mile is 19.354c.; the cost per car-mile 16.692c.; the cost per pound of delivery per mile .11128c.—average delivery 150 pounds per trip; cost per pounds of total delivery per day, .5232c.—900 pounds total delivery per day.

This last case, it is thought, represents very closely the true conditions now existing in this particular stable; but, to be on the safe side, the figures obtained under the first supposition will be used for comparative purposes in the next and final part of this report.

Nomenclature of Electrical Apparatus.

By Charles P. Steinmetz.

According to the direction of the energy transmitted, electric machines have been divided into generators and motors. By the character of the electric power, they have been distinguished as direct current and as alternating current apparatus..

With the advance of electrical engineering, however, these subdivisions have become unsatisfactory and insufficient.

The division into generators and motors is not based on any characteristic feature of the apparatus, and thus is not rational. Practically any electric generator can be used as a motor, and inversely, and frequently one and the same machine is used for either purpose. Where a difference is made in the construction it is either only quantitative, as, for instance, in synchronous motors a higher armature reaction is used than in synchronous generators; or it is in minor features, as continuous current motors usually have only one field winding, either shunt or series, while in generators frequently a compound field is employed. Furthermore, apparatus have been introduced which are neither motors nor generators, such as the synchronous machine producing wattless lagging or leading currents, etc., and the different types of converters.

The sub-division into continuous current and alternating current apparatus is unsatisfactory, since it includes in the same class apparatus of entirely different character, such as the induction motor and the alternating current generator, or the constant potential commutating machine, and the rectifying arc light machine.

The following classification, based on the characteristic features of the apparatus, has been adopted by the A. I. E. E. standardizing committee in its report. It refers only to the apparatus transforming between electric and electric, and between electric and mechanical power:

1st. *Commutating Machines,* consisting of a uni-directional magnetic field and a closed coil armature, connected with a multisegmental commutator.

2d. *Synchronous Machines,* consisting of a uni-directional magnetic field and an armature revolving relatively to the magnetic field at a velocity synchronous with the frequency of the alternating current circuit connected thereto.

3d. *Rectifying Apparatus,* that is, apparatus reversing the direction of an alternating current synchronously with the frequency.

4th. *Induction Machines,* consisting of an alternating magnetic circuit or circuits interlinked with two electric circuits or sets of circuits, moving with regard to each other.

5th. *Stationary Induction Apparatus,* consisting of a magnetic circuit interlinked with one or more electric circuits.

6th. *Electrostatic* and *Electrolytic Apparatus,* as condensers and polarization cells.

Apparatus changing from one to a different form of electric energy have been defined as:

A—*Transformers,* when using magnetism, and as

B—*Converters,* when using mechanical momentum as intermediary form of energy.

The transformers, as a rule, are stationary; the converters, rotary apparatus. Not included under converters are motor-generators transforming from electrical over mechanical to electric power by two separate machines, and dynamotors, in which these two machines are combined in the same structure.

1. *Commutating Machines* as *Generators* are usually built to produce constant potential for railway, incandescent lighting and general distribution. Only rarely are they designed for approximately constant power for electro-metallurgical work, or approximately constant current for series incandescent or arc lighting. As *Motors* commutating machines give approximately constant speed—shunt motors—or large starting torque-series motors.

When inserted in series in a circuit and controlled so as to give an e. m. f. varying with the conditions of load on the system, these machines are *Boosters,* and are generators when raising the voltage, and motors when lowering it.

Commutating machines may be used as *Continuous Current Converters* by transforming power from one side to the other side of a three-wire system.

2. While in commutating machines the magnetic field is almost always stationary and the armature rotating, *Synchronous Machines* are built with stationary field and revolving armature, or with stationary armature and revolving field, or as inductor machines with stationary armature and stationary field winding, but revolving magnetic circuit.

According to the number and character of the alternating circuits connected to them, they are single-phase or polyphase machines. As *Generators* they comprise practically all single-phase and polyphase alternating current generators; as *Motors,* a very important class of apparatus, the *Synchronous Motors,* which are usually preferred for large powers, especially where frequent starting and considerable starting torque are not needed. Synchronous machines may be used as *Compensators* to produce wattless currents, leading by over-excitation, lagging by under-excitation, or may be used as *Phase Converters* by operating a polyphase synchronous motor by one pair of terminals from a single-phase circuit. The most important class of converters, however, are the synchronous commutating machines.

Synchronous Commutating Machines contain a uni-directional magnetic field and a closed-circuit armature connected simultaneously to a segmental continuous current commutator and by collector rings to an alternating curcuit, mostly a polyphase system. These machines thus can either receive alternating and yield continuous current power as synchronous converters, or simply *"Converters,"* or receive continuous and yield alternating current power as *Inverted Converters,* or driven by mechanical power yield alternating and continuous current as *Double Current Generators.* Or, they can combine motor and generator action with their converter action. Thus a common combination is a synchronous converter supplying a certain amount of mechanical power as synchronous motor.

3. *Rectifying Machines* are apparatus which by a synchronously revolving rectifying commutator send the successive half waves of an alternating single-phase or polyphase circuit in the same direction into the receiving circuit. The most important class of such apparatus are the *Open Coil Arc Light Machines,* which generate the rectified e. m. f. at approximately constant current, in a star-connected three-phase armature in the Thomson-Houston, as quarter-phase e. m. f. in the Brush arc light machine.

4. *Induction Machines* are generally used as *Motors,* polyphase or single-phase. In this case they run at practically constant speed, slowing down slightly with increasing load. As *Generators* the frequency of the e. m. f. supplied by them differs from and is lower than the frequency of rotation, but their operation depends upon the phase relation of the external circuit. As *Phase Converters* induction machines can be used in the same manner as synchronous machines. Their most important use besides as motors is, however, as *Frequency Converters,* by changing from an impressed primary polyphase system to a secondary polyphase system of different frequency. In this case, when lowering the frequency, mechanical energy is also produced; when raising the frequency, mechanical energy is consumed.

5. The most important *Stationary Induction Apparatus* is the *Transformer,* consisting of two electric circuits interlinked with the same magnetic circuit. When using the same or part of the same electric circuit for primary and secondary, the transformer is called a *Compensator* or *Auto-transformer.* When inserted in series into an alternating circuit and arranged to vary the e. m. f., the transformer is called *Potential Regulator* or booster. The variation of secondary e. m. f. may be secured by varying the relative number of primary and secondary turns, or by varying the mutual induction between primary and secondary circuit, either electrically or magnetically. The stationary induction apparatus with one electric circuit are used for producing wattless lagging currents as *Reactive* or *Choking Coils.*

6. *Condensers* and *Polarization Cells* produce wattless leading currents, the latter, however, at a very low efficiency, while the efficiency of the condenser is extremely high, frequently above 99 per cent; that is, the loss of energy is less than 1 per cent of the apparent volt-ampere input.

To this classification may be added the *Uni-polar,* or, more correctly, *Non-polar* machine, in which a conductor cuts a magnetic field at a uniform rate. Thus far these machines do not appear of any practical value.

Regarding apparatus transforming between electric energy and forms of energy differing from electric or mechanical energy, the transformation between electrical and chemical energy is represented by the primary and secondary battery and the electrolytic cell, the transformation between electrical and heat energy by the thermophile, and the electric heater or electric furnace and the transformation between electrical and light energy by the incandescent and arc lamps.

The Traction Power Plant of the Paris Exposition.

It has already been explained in previous articles in these columns on the third rail road and the moving sidewalk at the Paris Exposition, that the current for these two important transportation systems

FIG. 1.—TRANSFORMER SUB-STATION, QUAI D'ORSAY.

is brought into the grounds for a large plant outside, in order to supplement the official supply of current from the service plant in the rear of Electricity Building. In view of the long delay in obtaining current from the service plant, it was a most providential thing that this plan was adopted, as otherwise the vitally necessary transportation systems could not have gone into operation until long

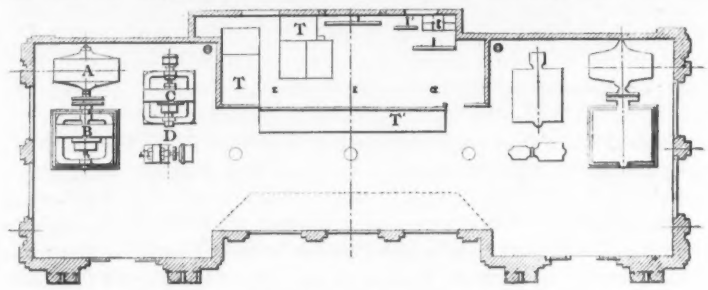


FIG. 2.—PLAN OF SUB-STATION.

A—Induction motor; B—Motor-driven generator; C—Rotary converter; D—40-hp motor-generator set; T—170-kw transformers; T'—Main switchboard; t—Automatic circuit breaker; t'—Automatic circuit breaker; t—high tension board.

after the opening of the show. Moreover, an excellent illustration has been furnished of power transmission and of the manner in which polyphase currents can be manipulated so as to feed direct current traction motors in the manner now becoming familiar in this country. Now that the Exposition draws to a close, it is realized that an excellent service has been given throughout, contributing in a marked manner to the comfort and convenience of the millions who have

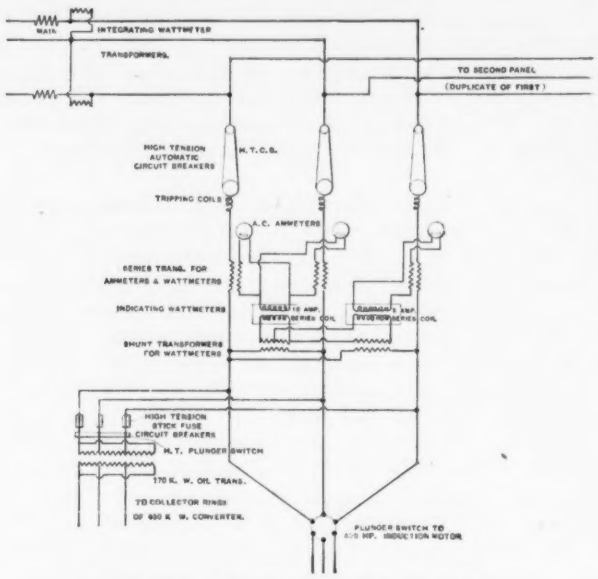


FIG 3.—DIAGRAM OF HIGH TENSION PANEL.

circulated within the Exposition grounds, between the Invalides section and that of the Champ de Mars.

The handsome sub-station, whose exterior is here shown, Fig. 1, is on the Quai d'Orsay, in the rear of the Army and Navy Buildings that front on the Seine, and receives current by means of two three-phase cables of 200,000 circ. mils., which go to headers behind the

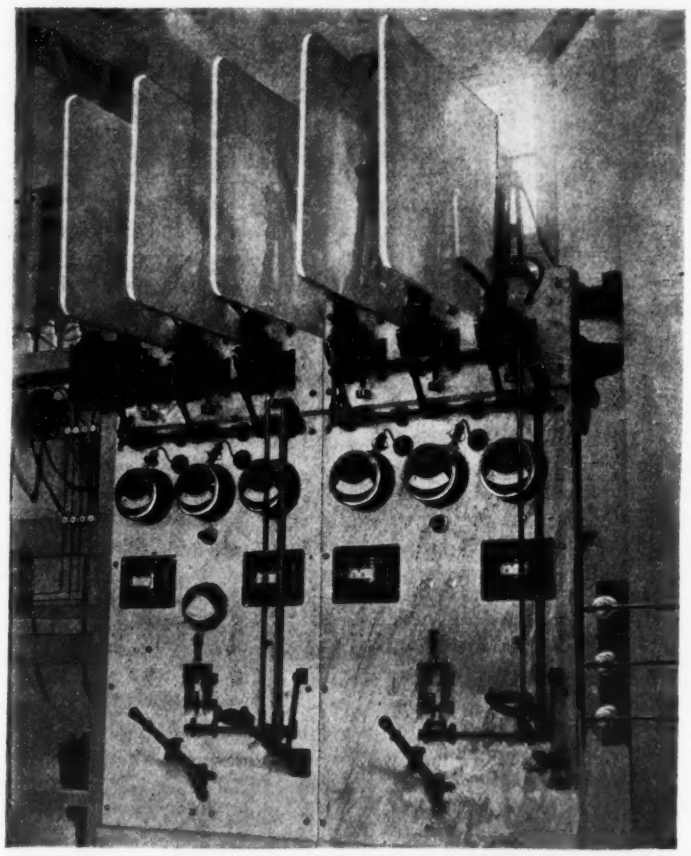


FIG. 4.—HIGH TENSION SWITCHBOARD, TRANSFORMER SUB-STATION.

high tension switchboard, and of which one is a reserve; the principle of duplication being maintained throughout the plant. The plan of the station is shown in Fig. 2, while Fig. 3 is the diagram of a high tension panel, shown in perspective in Fig. 4. The station contains six 10-kw oil-insulated self-cooling transformers, two 40-hp induction motors, direct connected to two 30-kw 500-volt generators; six 170-kw oil-insulated self-cooling transformers for the two 450-kw rotary converters with starting motors on their shafts, and two 850-hp induction motors direct connected to two 600-kw 500-volt generators. All the apparatus is Westinghouse. Two switchboards, Figs. 4 and 5, with marble panels, carry respectively the high-tension and low-

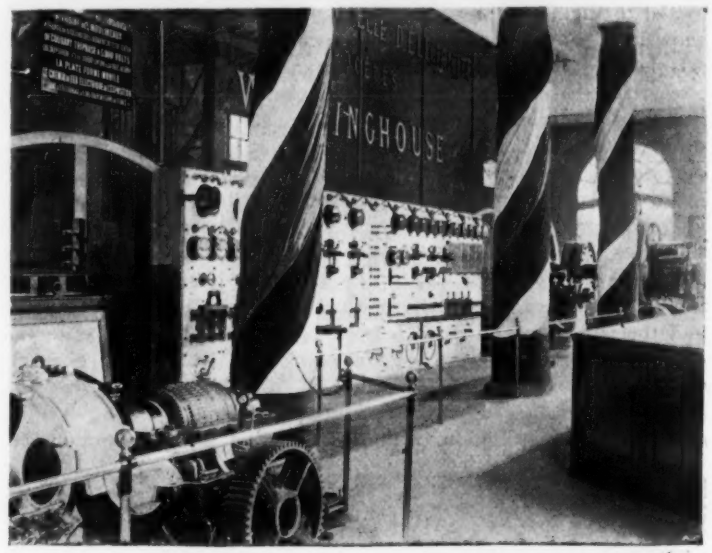


FIG. 5.—INTERIOR VIEW OF TRANSFORMER SUB-STATION.

tension cables, switches and instruments. The 10-kw transformers are for station lighting at 110 volts and for operating the 40-hp induction motors, which are started at 160 volts and then switched on to 220 volts. The 30-kw 500-volt generators direct connected to the 40-hp motors were installed to excite the large direct current generators when starting the sidewalk with the 5-hp motors connected in parallel. It was found, however, that the speed of the platform was too great with parallel connection of the 180 5-hp motors, and they have been run permanently two in series. The rotary converters were intended to supply current to the railroad, but, as there are two of these, one has been used to operate the moving sidewalk. The large motor-driven set is used to start the sidewalk, because the generator field may be gradually strengthened, starting off the sidewalk motors very gradually. The equipment of the third-rail road includes 9 trains of 3 cars each, of which 1 is a motor car with 4 Westinghouse 30-hp motors, and all these trains are in service almost all the time, often being crowded to excess.

After the 5000-volt three-phase current has arrived from Mou-

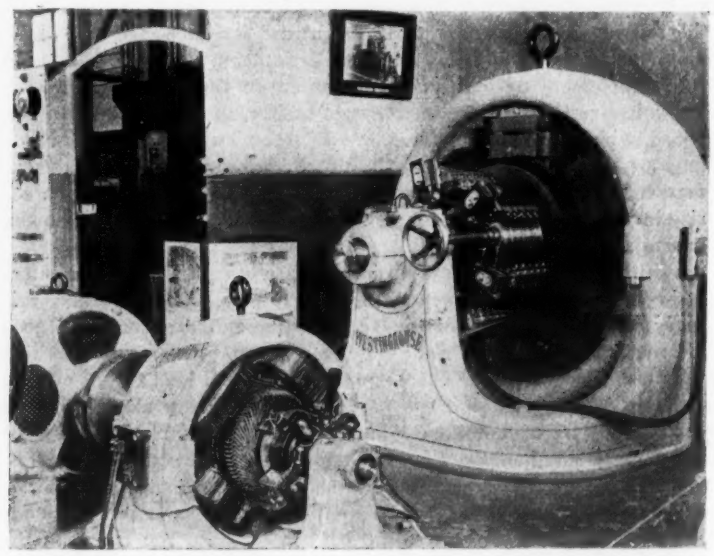


FIG 6.—SMALL MOTOR-GENERATOR SET AND ROTARY CONVERTER.

lineaux, it passes through the high-tension board, as shown in Fig. 3. At the bottom of each panel, as shown, is a plunger switch, which, when closed, connects the primary of an 850-hp induction motor direct to line at 5000 volts. Before reaching this switch, however,

a lead is tapped from each leg to the primaries of the six 170-kw transformers delta connected, passing through fuses and a plunger switch on the way. These transformers reduce the voltage from 5000 to 330 volts for the 450-kw 550-volt 6-pole compound-wound rotary converters. These converters run at 500 r. p. m. A three-phase 4-pole induction motor is mounted at the end of the shaft, for starting the converter and bringing it up to speed. It carries the rotary above synchronism, and is then cut out, and the rotary is connected to the alternating current mains as soon as the phase lamps show it to have dropped down to synchronous speed. One of these sets is used for the third-rail road, and the other is usually employed for the moving sidewalk, after the walk has been started up by one of the large motor-generator sets. The set is started from the direct curent end with current from the rotary that is already in operation. The direct current is cut off when synchronous speed has been reached, and the plunger switch is closed, throwing the big induction motor right across the three-phase 5000-volt mains. When the sidewalk is running at its normal speed, taking ordinarily about 300 amperes at 500 volts, the 600-kw generator is put in parallel with the second rotary converter, to which the load is then transferred, and the motor-generator set is shut down. Other details as to the operation of the road and the sidewalk have already been given in these pages.

The low-tension switchboard is seen in Fig. 5, standing well in the centre of the station, with the induction motor-generator sets

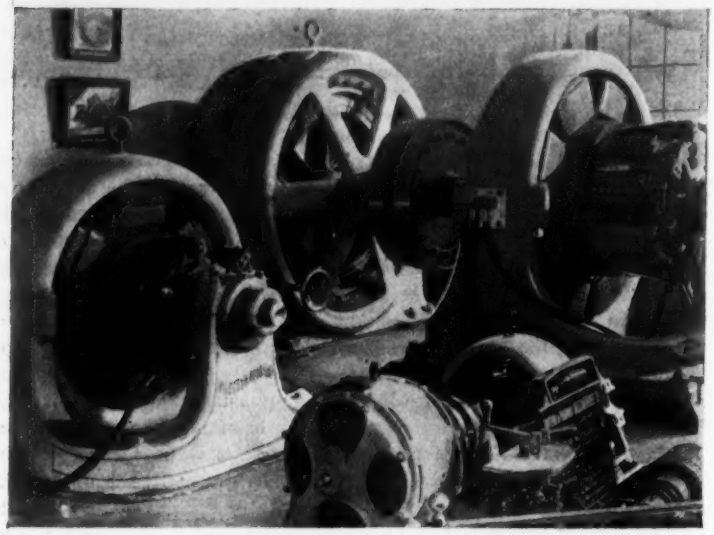


FIG. 7.—LARGE INDUCTION MOTOR AND DIRECT CURRENT GENERATORS.

and the rotary converters on each side, and the smaller transformers and incoming circuits in the rear. The board is iron, angle frame, with 13 marble panels, 6 of which to the left are for the rotaries and the railway feeders, and 7 to the right are for the large and small motor-generator sets and the sidewalk feeders. In addition to the full complement of instruments mounted on the panels, there is a 600-volt direct current voltmeter on a bracket at the left hand of the board, which can be read from any point, and which gives the readings of the rotaries. It may be noted, in passing, as an unusual feature of station construction, that the trunks of three large trees rise in front of the switchboard, the cutting down of any tree on the grounds being forbidden.

Without question, the 850-hp induction motors are the most interesting part of the equipment. They are 10-pole, with stationary primary windings and revolving secondaries, and are run with 3000 alternations per minute, while the direct current generators to which they are attached by flexible coupling have a full load rating of 1090 amperes and 550 volts at 290 r. p. m. The primary element of the motor consists of a hollow cylinder built up of laminated rings of sheet steel, mounted on the inside to receive the conductors. The rings are not continuous, but are made up of segments, which are dovetailed and fitted into corresponding slots in a hollow cylinder shell of cast iron, the shell being held in the cast-iron frame of the motor. The conductors are machine-wound coils of wire, thoroughly insulated before being slipped into the slots of the primary iron core. The secondaries are built up of laminated steel disks mounted upon an open spider, and the rectangular copper bars of the "winding" are carried in slots around the periphery. The conductors of the secondary are all purposely short circuited so that no accidental short circuit can occur to cause injury to the windings.

The operation of the sub-station has been very satisfactory all through the Exposition, for which much credit is due to the engineers in charge, Messrs. J. T. Wolfe, C. G. Koppitz, L. A. Phillips and W. A. Brown. The officials of the French Westinghouse Company, Messrs. Schmidt and Coster, are also to be congratulated upon the results of their general control and supervision.

EXPOSITION NOTES.

THE EXPOSITION BUILDINGS are now closed at 6 o'clock in the evening, instead of 6:30, owing to the shortening of the hours of daylight and lack of illumination. Want of light may possibly be responsible for the robberies which have been complained of by some of the exhibitors who have lost some of the articles placed on view in their stands.

ARC LIGHTING.—In the corridors behind the Chateau d'Eau and at other places are arc lights which are kept burning all the evening. As they are about 20 ft. above the floor level, and are not provided with slack wire or means for lowering, they are trimmed from a ladder. In order to obviate the fatigue and loss of time incident to climbing up to each lamp, the ladder is mounted on a two-wheeled truck and is moved from lamp to lamp by two men, while the trimmer stays at the top of the ladder.

THE COOLER WEATHER has made some parts of the Exposition buildings quite uncomfortable for exhibitors, as the construction of the walls is of temporary nature, and where glass is put in the air comes freely through at the edges of the panes. Along the galleries the October winds blow merrily, taking loose papers freely from the desks and tables, while the flags and curtains flutter strongly in the breeze. Ventilation, at any rate, is good now, but it would have been more appreciated in the hot days of July. Another feature of the last month of the show is the drop in the price of tickets, which are now selling singly at 3 cents, and in some cases they may be bought at the rate of two for 5 cents. The "select Friday," when four tickets are required for entrance in the evening, is more of a misnomer than ever.

THE LARGEST ALTERNATOR on exhibition is that shown by the Allgemeine Elektricitäts Gesellschaft, of Berlin, in the German Annex, Champ de Mars. This machine has an outside diameter of over 28 ft., and the revolving field of 72 poles is 24 ft. 3 ins. in diameter. Eight more of these alternators are being constructed and 13 are to be undertaken later, so that it is evident that large machines are being appreciated. Some eleven or twelve years ago this was not the case in England, for at that time Mr. S. Z. de Ferranti designed and built an alternator of 10,000-hp capacity for the central station at Deptford, the outside diameter being 40 ft. He was too far in advance of the time, however, for the machine was not set up, although nearly completed, and eventually was broken up and disposed of as old metal. In the foreign section of the Exposition power-house is the alternator by the Helios Company, of Cologne, which has the distinction of being the largest machine in operation.

Automobiles in New Haven, Conn.

The New Haven Electric Cab Company is soon to make additions to its Orange Street automobile stage line, which has met with flattering patronage. The buses now in use have already traveled over 4000 miles each, traveling 70 miles a day. They are 12 horse-power, but, being very solidly built, cannot be run on any very rough surface, such as cobble-stones, without a great degree of risk to the mechanism. The new buses are lighter and have 6 to 8 horse-power. The advantage to be gained is that they can run on any kind of pavement without any danger of interfering with the mechanism, and with these new buses 8-minute service will be given from the Union Depot to East Rock, along the route now covered.

These new buses will be six in number and of a different type from the present ones. The body will be somewhat higher, and in summer time the heavy top with glass windows can be removed and an awning substituted. It is a very neat looking affair and resembles a private bus for parties. The buses will arrive some time in November and will immediately be put in operation. The new buses have a speed rate of from 16 to 18 miles an hour. The old ones will either be sent to New York or used to carry special parties out to the Yale Field, Lake Whitney or like places.

In addition to this, the company is to erect an addition to its present Meadow Street building, and there will run a livery stable for electric, steam and gasoline machines.

A Practical Method of Impedance Testing for Telephone Men.

BY SEWALL CABOT.

The following application of Kempe's method for determining the value of L, the coefficient of self-induction in henries, may be found useful to telephone men and others who wish to calculate the resistance to alternating current of circuits containing impedance. The circuit containing impedance, and of resistance R ohms, is placed across the X terminals of a slide-wire bridge, in series with an adjustable non-inductive resistance R'. A condenser of known value K is also placed across the X terminals in multiple. Balance for resistance, and break battery circuit. The throw of the needle will be in one direction of the quantity of electricity discharged from the condenser is greater than that discharged by the circuit; or in the other direction if the quantity discharged by the circuit is greater. We may cut down the quantity to be discharged by the circuit by adding non-inductive resistance to it. When the two quantities thus discharged are equal, there will be no throw of the needle when the battery circuit is broken.

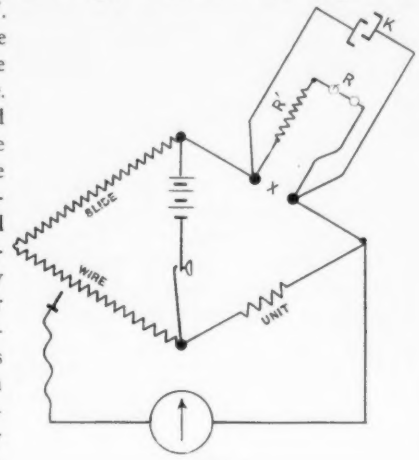


FIG. 1.

Textbooks tell us that the coefficient of self-induction L may be defined as the quantity of electricity induced when unit current is broken in circuit of unit resistance.

Assuming this quantity to remain constant, L will vary directly with the resistance $(R + R')$ and inversely with inducing current, or

$$L = \frac{Q\,(R+R')}{C}$$

The quantity of electricity discharged by the condenser, having a capacity of K farads is equal to $E\,K$, and furthermore equal to the quantity discharged by the circuit when condition of zero throw is

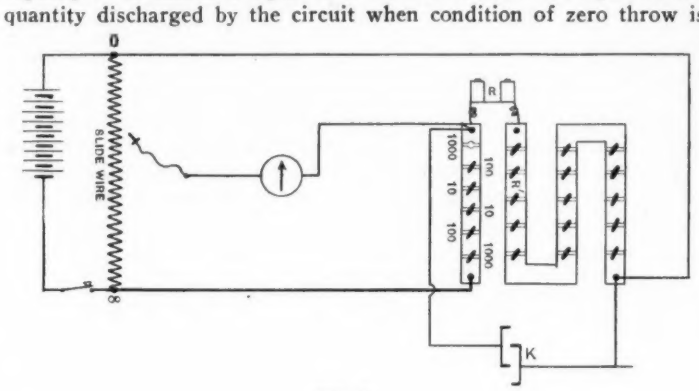


FIG. 2.

reached: therefore we may substitute $E\,K$ for Q in our formula for L, thus—

$$L = \frac{E\,K\,(R+R')}{C}$$

but $$C = \frac{E}{(R+R')}$$; therefore $L = K\,(R+R')^2$

In other words, the value of coefficient self-induction in henries is equal to the capacity of the condenser in farads multiplied by the square of the resistance shown on the slide wire.

As a practical illustration of this method, the following is given: It was desired to measure the value in henries of a 1000 ohm ringer. The slide wire used was 100 ins. of No. 32 B & S german silver graduated in decimal ratios, so as to read directly in ohms with units of 10, 100 and 1000 ohms. This graduation may be quickly done with the aid of a table of decimal reciprocals, as location of any ratio is distant in inches from the infinity end of the scale, 100 × decimal reciprocal of (ratio + 1). A post office bridge was used to provide the units and the adjustable non-inductive resistance.

A 2 m. f. condenser, 8 cells of Leclanche battery and a Weston portable galvanometer were connected up as shown herewith. The galvanometer had a resistance of 300 ohms, a time period 1 second for a complete vibration, a sensibility of 500,000 ohms per volt per division and became aperiodic with any resistance under 600 ohms shunting it.

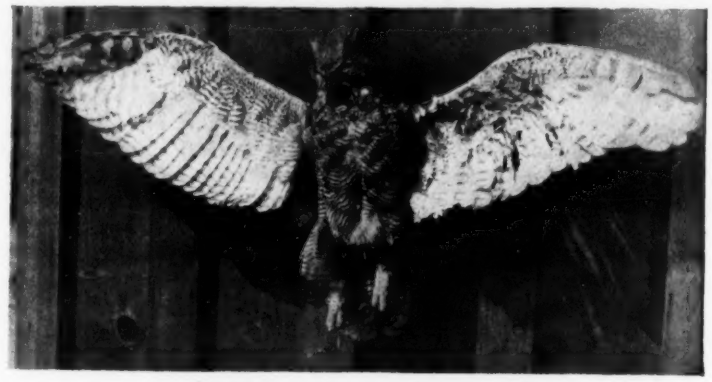
One thousand ohms was unplugged on the bridge arm strip for a unit, and resistance of ringer measured on the slide wire. Balance came on ratio .98, showing a resistance of 980 ohms. On breaking battery circuit the needle was thrown off the scale to the left, due to the predominance of the quantity of electricity discharged by the coil. Resistance was then unplugged and balanced on the slide wire until the throw on breaking battery circuit became zero, and finally changed its direction, showing that the quantity of electricity discharged by the condenser began to predominate.

At the point when the throw became zero, resistance of the coil + plug box was read off the slide scale, thus being 3250 ohms.

$$L = K\,(R+R')^2.$$
$$\text{or} = .000002 \times (3250)^2.$$
$$\text{or} = 21.1 + \text{henries.}$$

Effect of High Voltage on an Owl.

On the night of Sept. 14 a large owl flew into the 16,000-volt transmission line of the Montana Water, Electric Power & Mining Company, at Phillipsburg, Mont., short-circuiting the line and burning and killing the bird. The power plant at Flint Falls and the machinery in the mill at Phillipsburg were working as usual at the time, and the sudden shut-down was inexplicable until next morning



OWL KILLED BY 16,000 VOLTS.

when the patrol found the dead bird directly under the line. The photograph from which the cut was made was taken by Mr. Frank C. Pierce, the engineer in charge at the power house. It shows distinct marks of burning, particularly on one of the wings and on the head.

Some years ago, it will be remembered, an eagle came in contact with a high-voltage transmission line in California and was torn to pieces—a result quite different from that in the case above described.

McGill University.

During the summer months many important and needed improvements have been made in the mining and metallurgical department at McGill University, Montreal. One large machine, a Wetherill magnetic separator of considerable capacity, especially designed to be capable of application to a great number of ores, has been installed. This machine is a very recent invention, but it is already in use in certain places in the United States and Australia, with remarkable results. Experiments are already being made at McGill University to test its utility in the treatment of Canadian ores, and to discover if any modifications are necessary for its general use in the Dominion. A good many instruments from Germany and England have been added to the chemical laboratories. Notable among them are the German electric furnaces for experiments on a small scale in electrochemistry; the capillary electrometers and some chemical balances, which weigh to one-twentieth of a milligram, or one-thirteenth-hundredth part of a grain.

Effect of Wave Form on Capacity Current of Transmission Lines.

BY F. G. BAUM.

IT has been shown by Mr. C. P. Steinmetz that when there are harmonics in an e. m. f. wave, the capacity current as measured by an ammeter in series with the condenser does not follow the law of

$$I = E_{ef}\, C\, w,$$

in which E_{ef} is the effective value of the e. m. f. applied to the condenser, C the capacity and $w = 2\pi$ times the frequency.

In order to note any change in the ratio $\frac{I}{E_{ef}}$, that is, an apparent change in the reactance of the condenser, it is necessary that the effective value of the e. m. f. be measured by an electromagnetic voltmeter and not by an electrostatic instrument, because the latter being also a condenser, if there is a change in the ammeter reading there will be a corresponding change in the voltmeter, the ratio of the two readings being a constant and independent of the wave form.

The practical question will usually not be, How much is it possible to increase the apparent capacity of a condenser by distorting the e. m. f. wave? but with e. m. f. waves as given by good machines, How much increase or decrease in the apparent capacity may be expected?

We may assume that in *good* machines there will only be one maximum point in the e. m. f. wave for each half cycle; that is, suppose the e. m. f. wave be not "jagged," as in Fig. 1. Assume also no resistance connected in series with the condenser—this will give the greatest departure from the equation first given.

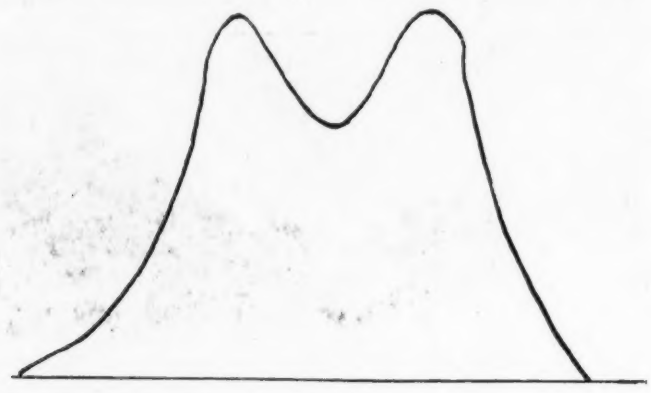


FIG. 1.—IRREGULAR WAVE.

Suppose an e. m. f. of *any form whatever* applied to a condenser—restricting a "jagged" wave—and consider the quantity of electricity which will pass the ammeter while this e. m. f. varies through one cycle. While the e. m. f. changes from zero to a maximum E the quantity passing the ammeter will be

$$Q = E_{max}\, C$$

and, of course, independent of the time it takes to reach a maximum value. For a complete cycle we will get

$$Q = 4\, E_{max}\, C$$

and for f cycles

$$Q = 4\, E_{max}\, C f$$

This is the total quantity of electricity passing the ammeter during f cycles. If, now, we assume the f cycles to take place in one second, Q becomes the quantity of the electricity per second; that is, the *average* current passing the ammeter is

$$I_{av} = 4\, E_{max}\, C f \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The equation shows that the average value of the current is independent of the wave form, since it depends only on the maximum e. m. f. The ammeter, however, indicates effective values, and although the average quantity will be the same for all e. m. f. curves having the same *maximum* the effective values will be different.

For a sine wave we have

$$I_{ef} = \frac{\pi}{2\sqrt{2}}\, I_{av} = \sqrt{2}\,\pi\, E_{max}\, C f \ldots\ldots\ldots\ldots\ldots (2)$$

Now an electromagnetic voltmeter at the terminals of the condenser will indicate effective values of e. m. f. and for a sine wave

$$E_{ef} = \frac{E_{max}}{\sqrt{2}}$$

and we have, finally, as the relation between the current, voltage, capacity, and frequency (sine wave)

$$I_{ef} = 2\pi\, E_{ef}\, C f \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Since $2\pi f = w$ this equation is

$$I_{ef} = E_{ef}\, C\, w \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The same equation as usually developed by a long mathematical process.

One extreme case is to consider a wave formed by two straight lines forming an angle at the maximum point, as in Fig. 2. We have

$$I_{av} = 4\, E_{max}\, C f$$

It remains to express the effective value of the current in terms of the average value and the effective value of the e. m. f. (that is, the e. m. f. as measured by an electromagnetic voltmeter) in terms of the

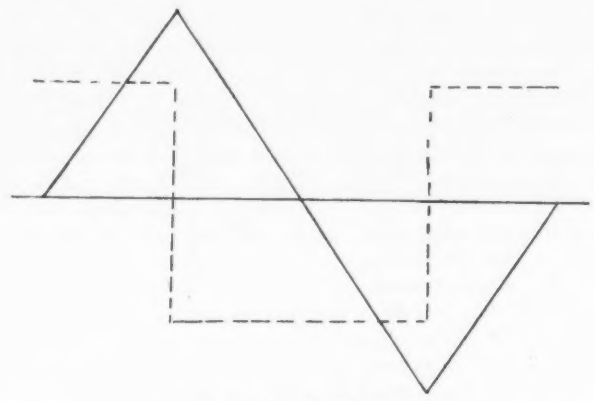


FIG. 2.—SAW-TOOTH WAVE.

maximum value. It can easily be proved that the effective value of the e. m. f. would be

$$E_{ef} = \frac{E_{max}}{\sqrt{3}}$$

and we have

$$I_{av} = 4\sqrt{3}\, E_{ef}\, C f$$

Now, the instantaneous current in the condenser depends on the rate of change of the e. m. f., and since the rate of change of the e. m. f. is constant, the wave of current will be rectangular in form, as indicated by the dotted line in Fig. 2. That is, the current through the ammeter is constant, and, therefore, the average value is equal to the effective value. (It is well to note that only for a sine wave of e. m. f. will the current and e. m. f. have the same form.) We have then, for a triangular wave

$$\text{(Triangular e. m. f.)}\ I_{ef} = 4\sqrt{3}\, E_{ef}\, C f \ldots\ldots\ldots\ldots\ldots (5)$$

Suppose we compare the current to the condenser for a sine and triangular wave for the same effective value of the e. m. f., that is, for the same voltmeter reading. Taking the ratio of equations (5) to (3), we obtain

$$\frac{\text{(Triangular e. m. f.)}\ I_{ef}}{\text{(Sine e. m. f.)}\ I_{ef}} = 1.12$$

Or, the triangular wave will give 12 per cent larger current than the

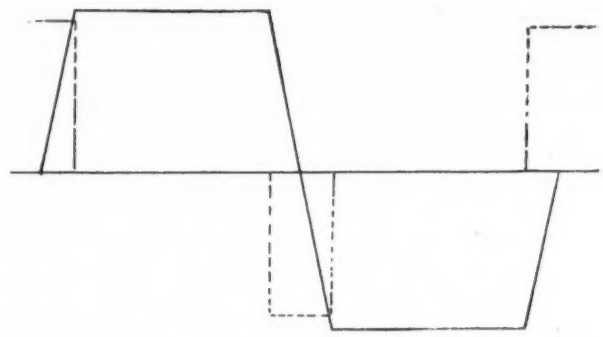


FIG. 3.—FLAT-TOPPED WAVE.

sine wave. We see that even with a wave as peaked as here assumed the apparent capacity of the condenser would only be increased 12 per cent.

It is impossible to analyze the other extreme case, a rectangular e. m. f. wave, because the rate of change of e. m. f. is either infinity or zero.

The wave formed by three straight lines, as in Fig. 3, could be

analyzed and compared with the sine wave. The mathematical work, however, becomes complicated. We can easily see that for the same effective value the maximum e. m. f. will be less than for the sine wave, and, therefore, the average quantity of electricity flowing through the ammeter will be less than with a sine wave, and, consequently, less than with the triangular wave. The wave form of current through the ammeter will be rectangular in form, but discontinuous, as indicated by the dotted lines in Fig. 3. By taking certain cases there will be no difficulty in proving that the smaller the difference between the maximum and effective value of the e. m. f. the smaller will be the apparent capacity of the condenser.

A peaked e. m. f. wave, therefore, will give a larger apparent capacity, and a flat e. m. f. wave will give a smaller apparent capacity than a sine wave. With a wave having several maximum points for each cycle—that is, with a "jagged" wave—we may get a very large increase in the apparent capacity. A saw-tooth wave would, therefore, not be permissible on long distance transmission lines; for a line 100 miles in length with 40,000 to 50,000 volts between wires, it takes about 1500 kilovolt-amperes to charge the line using a sine wave of e. m. f. With a "jagged" wave this may be increased two or three times, which may mean a larger generating and step-up transformer capacity to charge the line than would be needed at full load. With machines giving smooth waves, although the waves may be peaked or flat, the charging current of the line will not differ much from the calculated value, assuming a sine wave.

On the Apparent Emission of Cathode Rays from an Electrode at Zero Potential.*

BY CHARLES E. S. PHILLIPS.

It has been noticed by many people who work with X-ray and other vacuum bulbs that numerous bright green patches occasionally appear upon the inner surface of the glass walls of a bulb while a discharge is passing, especially during the process of exhaustion.

These green flecks vary considerably from time to time both in shape as well as in position, and efforts have been made to connect their existence either with want of uniformity in the composition of the glass or with irregularities in the surface of the negative electrode.

I have already, in another place,[1] given some account of an experiment made with the object of clearing up this uncertainty, and now beg to supplement that work with the following observations as to the cause of the phenomenon. The experiment just referred to consisted in using a pivoted disk of aluminum as the negative electrode in a bulb containing rarefied air, so that when green patches appeared a rotational movement of the disk (actuated by means of an external magnet) would show whether the patches of green moved in a corresponding manner or not. It was seen that they did so move.

A distinct feature of the experiment, however, consisted in ascertaining whether those flecks which persisted after the discharge had ceased were still sensitive to movements of the cathode. This also was found to be the case. The proof, therefore, that the green patches were associated with an emission from the cathode appeared complete.

But it was further noticed that subsequent to the passage of a discharge, and even when either or both of the electrodes were connected to earth, still the green flecks were easily visible upon the glass walls of the bulb, and continued to move as before when the cathode was rotated.

This was apparently a case in which cathode rays were emitted from an electrode at zero potential.

I do not know that any explanation of this effect has so far been offered, and I therefore venture to bring forward the following suggestions, supported by further experiments.

When a piece of metal is placed in a rarefied atmosphere and made the negative pole for an electrical discharge passing across the attenuated gas, innumerable small bright specks of light appear over the surface of the metal. It was found convenient in my particular case to use an *iron* electrode for observations of this effect, because it had the advantage of being readily magnetizable from without. The addition of a similar iron electrode to act as the anode determined the shape of the magnetic field. With such an apparatus it could be seen that the bright spots appeared principally upon the *cathode* while the discharge passed, and that the creation of a magnetic field between the electrodes made visible the individual luminous streams of gas emanating from those tiny points of light. The paths of these luminous streams, becoming bent by the action of the magnetic field, followed the direction of the lines of magnetic force and exhibited a tendency to become spiral in accordance with well-known laws. In this way a fine layer of sodium upon the anode was caused to fluoresce through the action of the negatively electrified particles beating down upon it. One was able, in fact, by this means to cast shadows of objects placed in the paths of the bent streams, and at a pressure considerably higher than that necessary for the production of the well-known cathode shadow effects. In the above case, however, the method served to clearly establish the fact that the bright points of light upon the surface of the cathode indicated the places from which the jets of gas originated.

The number of these jets became less as the exhaustion was continued, and individual streams were very clearly seen owing to the action of the magnetic field. When the discharge began to cause fluorescence in the glass of the bulb some green patches made their appearance, and, in some cases, when the cathode was magnetized a bright spot, which was previously judged to indicate the origin of a green patch upon the glass, would shift to a new position upon the electrode. In all such cases the corresponding patch also moved in a similar manner upon the glass.

At sufficiently high exhaustions the bright spots upon the electrode disappeared entirely, although green flecks were still visible upon the glass. But a movement as before of the electrode as well as its magnetization gave results consistent with previous observations.

Under these conditions, when the discharge through the bulb was stopped, green flecks were still visible for about ten seconds.

A positively charged body was brought up to the outside of the bulb and the patches brightened considerably. A negative charge similarly placed extinguished the flecks completely. This was also the case when the electrodes were connected to earth.

Finally, vacuum bulbs, such as X-ray lamps, etc., exhibiting green flecks while in operation, were generally found to deteriorate if laid aside for a month or two, owing to an increase in the pressure of the contained gas. We see, therefore, that, in the first place, the bright points of light upon the surface of the cathode are due to the emission of fine jets of gas; also that such jets, if negatively charged, may be made to cast shadows of objects suitably placed in their paths. It is at the same time clear that the green flecks referred to above are due, during the passage of a discharge, to these same jets of gas impinging upon the inner side of the glass walls, and that, under the conditions existing immediately subsequent to the passage of the discharge, it is evident that streams of gas continue to be emitted from the pores of the electrodes. In spite of the fact that with the electrodes connected to earth these streams consist of unelectrified particles, they assume that property of ionization during their passage across the space within the bulb which appears to be essential to the production of local fluorescence in the glass upon which they impinge.

This latter effect, while explaining the process by which a cathode emission may appear to originate at an electrode with no electrical charge upon it, is one to which I wish to draw especial attention, for there is reason to believe that the upper limit of speed for the individual particles constituting the jets cannot exceed the rate at which sound is propagated.

It is therefore interesting to find that, under such circumstances, fluorescence was produced in the glass upon which the streams impinged.

As many of the observations referred to here were made during the course of an investigation into the diselectrifying action of magnetism now being carried out by myself at the Davy-Faraday Laboratory of the Royal Institution, I desire to express my indebtedness to the managers of that institution for the facilities which they have kindly placed at my disposal.

*Abstract of paper read at the British Association meeting, Bradford.
[1]London *Electrician*, 41, 1898, pp. 425-426.

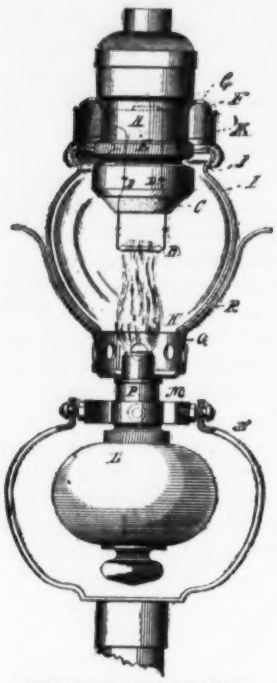
Method of Operating Nernst Lamps.

Mr. John Van Vleck, the well-known electrical engineer, and Mr. W. N. Stevens, have taken out a patent which discloses two or three kindred methods of starting up lamps of the Nernst type. Their invention, shown in the cut, consists broadly in the use of a removable flame-producing burner to heat the member normally non-conducting; and means for guiding the heater.

The accompanying drawing shows the lamp with the guard device

in section and the heating lamp applied thereto. *A* is the cylindrical support for the glower *B*, which is secured on the lower face *C* of said support. At *D* are circuit wires whereby current is conducted to the glower *B*. The support *A* is provided with a flange or collar at *E*, which receives the curved-over ring *F*. In the arched upper side of this ring are numerous openings *G*. Secured to the outer side of the ring *F* is any suitable holding contrivance, such as clips *H*, which receive and hold the upper flanged portion of the glass guard-globe *I*. Between the flange of the globe *I* and the clips *H* is preferably interposed a gasket *J*, of asbestos or similar material. In the lower part of the guard-globe *I* is an opening *K*.

The heating device may be in the form of a lamp *L*, adapted to burn alcohol or other spirit, which will produce a substantially-smokeless flame and the reservoir of which is supported in a universal joint, such as gimbals *M*, in a fork *N* upon a suitable rod or handle *O*. Surrounding the lamp burner *P* and secured upon it is a ring *Q*, provided with air-openings and with upwardly and outwardly inclined arms or fingers *R*.



NERNST LAMP HEATER.

The relation and sizes of the several parts are made such that when the lamp is placed in position and centered, as described, the flame will reach the glower to heat it. In the construction shown in the cut the draft passes in through the openings in the ring *Q* and escapes through the openings *G* of the ring *F*. The device provides for the proper placing of the heating flame with respect to the glower to heat the latter, while preventing any danger of the lamp burner striking or coming in contact with the glower. The lower surface *C* of the glower support, which is directly above the glower, is made of refractory material, so as not to be injured by the heat of the flame, and also to receive the direct impact of the flame or hot air, and thus to protect the support above. The periphery of this refractory surface is made inclined, substantially as shown, so that it may act as a deflecting surface to direct the upward hot-air current into the annular passage which surrounds the support *A* and which is formed by the sleeve produced by the ring *F* and globe *I*. From this annular passage the hot air escapes by the openings *G* in ring *F*. This passage thus acts like a chimney, increasing the draft on the flame and facilitating its action upon the glower.

CURRENT NEWS AND NOTES.

CABLE STEAMER "BURNSIDE," en route for the Philippines, is reported as having reached Gibraltar.

PROF. JOHN PERRY informs us that his admirable "Calculus for Engineers" is being brought out in a German edition.

NOISE OF DYNAMOS.—Action has been begun in New York against the Third Avenue Railroad for noise and shock alleged to be due to its generators in the up-town plant on Amsterdam Avenue. A similar suit has been brought against the New York & Staten Island Electric Company, in regard to its apparatus at Livingston.

TELEPHONIC POLITICAL ORATORY.—The United Telephone Company, at Bluffton, Ind., is giving a political speech service this fall. The campaign speeches are made in the circuit court room at Bluffton and a telephone transmitter is put in front of the speaker with which connections can be made with fifty telephones throughout the city.

COURTING BY TELEPHONE.—A Cleveland correspondent reports that a number of seamstresses employed by a prominent dress-making establishment in that city have gone on strike because the management removed the privilege of the use of the telephone. Calls by the "best fellows" of the young ladies grew to be more numerous than the establishment could stand.

CLEVELAND ELECTRIC CLUB.—At the recent annual meeting of the Electric Club of Cleveland new officers were elected, as follows: Charles W. Wason, president; P. Yenson, vice-president; Charles W. Powell, second vice-president; D. M. Hosford, secretary; George M. Hoag, treasurer, and George B. Tripp and S. K. Elliott, members of the board of managers. After the business meeting there was a fine musical programme and lunch.

MAIN LINE TRACTION.—At the annual meeting of the stockholders of the Concord & Montreal Railroad it was voted to build a road to be operated by electricity through the Merrimack Valley from Concord, N. H., to Hudson, N. H., there to connect with the Nashua Electric Railroad system, and also for a through route by trolley to Boston. The issue of bonds in amount not to exceed $1,000,000 was authorized to pay for trolley construction.

AUTOMOBILE CONTESTS.—The programme for the competition at the Automobile Show at Madison Square Garden, New York, Nov. 3 to 10, has been announced. The contests will be conducted under the direction of the Technical Committee and the Contests and Exhibition Committee of the Automobile Club of America. There will be afternoon and evening contests, as to obstacles, braking and stopping, for all classes of automobiles.

LEAGUE OF AMERICAN MUNICIPALITIES.—The fourth annual convention of the League of American Municipalities will be held in Charleston, S. C., Dec. 12-15 next. The programme includes the discussion of many topics of interest to municipal officials. Municipal ownership of public service industries, and remuneration to cities for franchise rights, in, over and under public streets and alleys, will be considered. Mr. B. F. Gilkison, 111 Nassau Street, New York, is secretary of the league.

THE NEW TELEGRAPH COMPANY.—The Chicago Board of Trade has requested the New York Produce Exchange and other exchanges to make tentative contracts with the Exchange Telegraph Company, which was recently incorporated in New Jersey through the influence of the Board of Trade, as one step in its fight with the telegraph companies over the use of its quotations on their tickers. The Produce Exchange quotations are now being circulated by the telegraph companies over the tickers which formerly carried the Chicago quotations. The contract of the Produce Exchange with the telegraph company is said to provide that the quotations shall not be furnished to "bucket shops." It is reported in Produce Exchange circles that the Chicago board wishes the several grain exchanges of the country to sign contracts with the new telegraph company, giving the latter exclusive privileges in regard to quotations for twenty years.

CURIOUS EFFECT OF LIGHTNING.—Mr. L. H. Lancaster, the manager of the Cumberland Telephone & Telegraph Company's exchange at Thibodaux, La., gives us some facts concerning the peculiar effect of a lightning bolt at Beattieville, La., recently. This occurrence was referred to in our issue of Sept. 22. The lightning entered the store of Mr. A. Gautreaux over the telephone wire, passed down the hanging hand cord and jumped to a repeating rifle which stood close by. It then passed down the barrel of the rifle and splintered the stock and a plank in the floor upon which the rifle was standing, thence passing to the ground. The cord and gun stock were irretrievably ruined. Mr. Lancaster has sent us the cord for examination. In a portion of its length the copper wires have been completely dissipated, while the cotton cord remains unburned, although it is badly torn. The telephone itself was unharmed, the lightning seeming to expend its energy on the rifle stock and floor.

ELECTRIC TREATMENT OF RHEUMATISM.—Sir James Grant, M. D., of Ottawa, who is engaged in making original investigation into the uses of electricity as applied to human ailments, says that for many years he has been in the habit of treating cases of supposed muscular rheumatism by the insertion of small (No. 8), fine steel needles, the number varying according to the extent of the affected parts, and, as a general rule, the seat of pain will indicate the precise

place and extent to which the needles should be used. They remain stuck into the muscles for one to two minutes. The previous hard, tense condition, approximating one of tetany, relaxes and the patient is able at once to use the muscles. Experiments point to an abnormal storage of electricity in the tissues. It may be stored as a result of sudden draughts and cold. When the inserted steel needles are touched, the electrical accumulation is discharged, passing through the body of the operator without any serious result. There is almost immediate relief in lumbago from this acu-puncture.

LETTERS TO THE EDITORS.

The Blue and Gray Together.

To the Editors of Electrical World and Engineer:

SIRS:—In these days of sharp electrical competition, still very active ones for me in the wider development of electrical railroading, it was a matter of very agreeable surprise to read the kindly reference to my early work, by Mr. John C. Henry, in your issue of Sept. 29. I beg to express through you my thanks to him for his courtesy, and to offer a reciprocation of appreciation for his very hard and earnest work in the earlier days of electric railroading.

As time goes by, the asperities engendered gradually lessen, and those of us patriarchs who are still living, or remain in the fighting, appreciate more and more the work done and the great difficulties encountered by our former co-laborers, among whom it is but just to make special mention of Leo Daft, still happily alive, and Charles J. Van Depoele, who has quit hunting trouble.

NEW YORK CITY. FRANK J. SPRAGUE.

Those Paris Awards.

To the Editors of Electrical World and Engineer:

SIRS:—The editorial in your last issue under the heading of "Paris Awards" necessitates a reply from those attacked by it, as your figures give a much more misleading and unjust impression than you claim for the statement that "the United States received a higher total of awards than any other nation, save France, and that she also received more awards in each classification, except grand prizes, in which Germany secured a greater number." The truth of the latter statement does not seem to be questioned.

In your argument you measure the importance of a country and of its products by the ratio of the number of grand prizes and gold medals to the number of entries in a catalogue. The absurdity of this and the injustice it does to a large country is readily shown by an example. Suppose some small, distant, unimportant, half savage country had sent only a single but very good exhibit for which it had received a grand prize, and suppose that it had entered this only once in the catalogue. It would, according to your argument, be the leading country in the world, as its figure of merit, according to your scale, would be unity, the highest possible ratio obtainable. No other country could equal it unless it received as many grand prizes as it had entries, which is practically impossible for a large country. It would, moreover, be ten times as important a country, and its products would be ten times as good (according to your system of ranking them) as in the case of a very large country which had 300 entries in a catalogue, 200 of which never materialized as exhibits, and 30 out of the 100 actual exhibits receiving grand prizes or gold medals, most of the others having also received awards below a gold medal. The absurdity of your method of ranking is therefore evident.

You have, in your figures, evidently taken the number of "entries" from a catalogue prepared before the jury work began. As a matter of fact, many of the entries for the United States never materialized as exhibits. I do not know the exact proportion for the whole electrical group, but in the class for which I was the juror, the record shows that only about 40 per cent of the exhibitors which were entered in the catalogue really exhibited. The proportion in the other electrical classes was probably not very different. In some of the other foreign countries with which you make a comparison there were, on the other hand, even more exhibits than those in the catalogue. Moreover, in the class with which I was concerned, there were many small American exhibits consisting sometimes of only one or two samples, half a dozen or more exhibits being sometimes together in a small case. None of these, of course, could expect much of an award. The few exhibits of some of the other countries, on the other hand, were nearly all large.

Moreover, as you know quite well, some of our large manufacturers who would have received grand prizes did not exhibit at all, or had only very small exhibits, or were not entitled to awards on account of being represented on the jury. The exhibits of the United States in the electrical group did not adequately represent the importance of that industry in this country. Under the circumstances it is very unjust to claim, as you do, that "neither our commissioners nor our jurors were successful in protecting the interests that had been confided to them." There were comparatively few electrical exhibits from the United States that received no award at all, and there was always a good reason. In my opinion the American electrical exhibitors can well "feel satisfied with the recognition they received," and I believe that most of them do.

ONE OF THE U. S. JURORS FOR GROUP 5 (ELECTRICITY).

[As to our general discussion of the awards, that speaks for itself; but we would like to say that our analysis conforms entirely with that of London *Engineering*, as quoted recently. That excellent paper, like ourselves, has expressed its surprise at the meagreness of the awards gained by the United States, and has, by the way, accompanied its criticism with some very pertinent remarks on the duties of jurors to those whose interests are confided to their care. As to the general satisfaction of exhibitors, that is still a matter of opinion. For example, to take only one new case, a special dispatch from Paris of Oct. 13 says: "Mr. Remington, head of the Fire Arms Company and the Remington-Sholes Typewriter Company, relentlessly pursues his campaign against what he calls the infamous corruption of the American Exposition Commission, which he has sworn to expose here and in Congress at Washington. His agents again testify, through English printed Paris papers, to strange facts connected with space allotment and awards among the United States exhibitors." These are not pleasant matters to discuss or to note, and we trust are not true; but it is the fact that the air is full of such incidents, which can hardly be overlooked.—EDS. E. W. AND E.]

Resonance and Coherence.

To the Editors of Electrical World and Engineer:

SIRS:—Having read in your pages several articles relating to resonance and coherence, and as the phenomenon has come under my observation several times, the facts in this case may be interesting to your readers.

When a heavy discharge occurred, the lamps and the voltmeter would show a sudden drop in voltage; in an instant, however, they would regain their normal voltage and also show a rise of several volts; from the voltmeter chart, on a 110-volt circuit the drop would be sometimes as low as 102, *i. e.*, 8 volts drop, and the rise in direct proportion, which would be 118 volts; sometimes the rise and fall exceeded even this, and again was hardly noticeable. I do not believe, however, the phenomenon is due to coherence, because of the fact that if the resistance of the filaments decreased instantly the candle-power would practically increase instantly, but, as before stated, the candle-power of the lamps first fell and then rose above normal. Also, again, if the filaments did cohere, the number of lamps under consideration would hardly cause the drop in voltage of the machine of the capacity considered with its load.

To state further, I would say that, if I remember correctly, I saw in an issue of several months back of the ELECTRICAL WORLD AND ENGINEER, under "Current News and Notes," where "a discharge entered a station and completely stopped an alternator"; however, no damage resulted to the insulation of the machine or otherwise. Now, if a discharge, when conveyed to the machine through the line, would have a tendency to throw an apparent load on a machine, and the insulation did not break down, the voltage would, of course, drop, and thereby cause the speed to vary; and as the load, or apparent load, is instantaneous, the regulation would be, to a certain extent, radical, thereby causing the drop and rise heretofore referred to.

I should think the effect would be the same with direct current apparatus as with alternating. However, the above case was noted in connection with alternating. The question seems to be largely hypothetical. I might add that if the above phenomenon had occurred on underground systems, it would then seem that it might be due to coherence.

S. H. S., JR.

North Carolina.

Suburban Overhead Double Trolley Lines.

To the Editors of Electrical World and Engineer:

Sirs:—In the issue of the Electrical World and Engineer of Oct. 6, there is an article on "Suburban Overhead Double Trolley Lines, Washington, D. C.," in which the statement is made that the district authorities "require the double trolley system." It is further stated that "it is difficult to understand why single trolley and track return would not be entirely adequate for the conditions of safety required by park land and cornfield, but the exactions of the authorities of the District of Columbia have certainly led to the construction of a very interesting and excellent piece of double trolley work." I beg to state that the portion of the electric railway mentioned in this article, and as shown by the illustration, is outside of the limits of the District of Columbia, and is not under the control of the district authorities. The total length of the line from its terminus in Washington to the town of Rockville, Md., is slightly over 14 miles. Of this, approximately 4¼ miles are within the limits of the District of Columbia.

When the Washington Traction & Electric Company secured the control of this line, it found that portion within the District of Columbia to be in very bad condition, and it immediately began the rebuilding of the overhead portion of the line. Owing to the efforts of the District authorities to require all lines within the district to be double trolley, and to the fact that their efforts will undoubtedly result in securing legislation to that end, the company voluntarily rebuilt the line on the double trolley system. It is, however, not operated as such, but is operated as a single trolley line with a ground or rail return, which accounts for the statement in this article that the rails have been bonded at the joints.

Of the nine railroad companies controlled by the Washington Traction & Electric Company in the District of Columbia, only one of them is required by law to operate with the double trolley system. In rebuilding the lines over which they secured control, however, they have equipped four of them with the double trolley system, among which is the one mentioned in this article.

Washington, D. C. Walter C. Allen,
District Electrical Engineer.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos, Motors and Transformers.

Alternators in Parallel.—Perot.—A mathematical French Academy paper, in which he first considers two alternators connected in parallel, which have e. m. fs. with identical fundamental waves and identical higher harmonics, the only difference being that the wave of one alternator has a special higher harmonic which is missed in the wave of the other alternator; he calculates the current which is due to this special higher harmonic, and the e. m. f. at the terminals of the two alternators. This is proportional to the ratio of self-induction of the alternator, which has not that special higher harmonics and the sum of the self-inductions of both alternators. He then deduces the results for more than two alternators in parallel. He considers an alternator, the wave of which has higher harmonics, and supplies current to a synchronous motor of small power and of small self-induction compared with that of the alternator; the motor may be supposed to be normally excited and unloaded; it behaves like a machine with a sine wave coupled to the alternator, so that the formula mentioned above can be applied; it follows that the e. m. f. at the terminals of the alternator, due to the higher harmonics of the alternator, is decreased in the ratio of the self-induction of the motor to the sum of the self-inductions of motor and alternator, which ratio was supposed to be very small; in other words, the e. m. f. at the terminals of the alternator becomes nearly a pure sine wave.—*L'Eclairage Elec.*, Sept. 8.

Theory of Synchronous Motors.—Seefehlner.—The first parts of a long, illustrated paper in which he gives a "contribution to the theory of synchronous motors and alternating-current generators." He treats the synchronous motor and the alternating-current generator, analogously to the calculation of the induction motor, as a special case of the general transformer. The synchronous motor appears as a special case of the induction motor, the slip being constant and always zero. He modifies the Heyland diagram so that he can develop graphically the properties of the synchronous motors, and gives also a graphical method of calculation of the loaded alternating-current generator. His results are somewhat similar to those of Rothert, but differ from them in several special points. He gives an account of experiments which he made with a three-phase alternator, and which were in agreement with his theory.—*Zeit. fuer Elek.*, Sept. 16, 23.

REFERENCES.

Induction Motor.—An illustration of a 1000-hp, 5000-volt, two-phase, induction motor, making 455 revolutions, built by Brown, Boveri & Company, for driving a centrifugal pump at the Geneva Water Works, pumping water to a height of 460 ft., which is unusually high for a centrifugal pump. It is claimed to be the largest induction motor in the world.—Lond. *Elec. Rev.*, Sept. 28.

Starting Three-Phase Induction Motors.—Rhodes.—Some remarks regarding the method of Fischer-Hinnen, described in the Digest Sept. 1. He thinks that the advantage of the automatic cut-out is more than balanced by the disadvantage of a diminished power factor and a diminished starting torque.—Lond. *Elec. Rev.*, Sept. 7; reprinted in *Elec. Rev.*, Oct. 3.

Diagrams of the General Transformer.—Heubach.—An illustrated communication in which he shows a mistake in the communication of Emde (Digest, Oct. 13). He also shows that some objections may be made against the deduction of the Heyland diagram.—*Elek. Zeit.*, Sept. 27.

Induction Motors.—Fischer-Hinnen.—A list of misprints in his long serial (Digest, Aug. 18, Sept. 8).—*Zeit. fuer Elek.*, Sept. 9.

Lights and Lighting.

REFERENCES.

Behavior of Incandescent Lamps During Lightning Storms.—W. S. Andrews.—A brief communication referring to the observation made in Calcutta, as noticed in the Digest Sept. 22. He has once or twice witnessed the same phenomenon in the United States; each time it occurred simultaneously with an exceptionally vivid lightning flash, and in lamps connected with an overhead system of conductors.—Lond. *Elec.*, Sept. 28.

Illumination.—Packer.—An illustrated article on electrical illuminations for the celebration in San Francisco, of the semi-centennial of California's admission into the Union.—*Elec. Rev.*, Oct. 3.

Manufacturing Incandescent Lamps.—An illustrated description of the Malignani process of exhaustion (Digest, Sept. 29).—*Sc. Amer.*, Oct. 6.

Power.

Water-Power from the Rhone.—Bonnefond.—A paper on the water-power available and the schemes for utilizing it at the upper parts of the Rhone. The minimum horse-power which can be obtained in the driest months is 100,000 horse-power, while for nine or 10 month at least 200,000 horse-power are available. At present only 10,000 horse-power are used, but three schemes are being organized by French companies, for providing 25,000, 30,000 and 30,000 horse-power, respectively. These three schemes are described.—*Bull. of the Soc. des Ing. Civ. of France*, August; abstracted in Lond. *Elec. Eng.*, Sept. 28.

Electric Power from Wind Turbines.—Conz.—A brief article describing a test made with a wind turbine driving a dynamo, by which a battery is charged; the battery supplied the current for lighting a factory. The test was made on a day when the wind was variable. At a speed of 2 meters per second the dynamo was unloaded; when the wind speed became 2.5 meters per second, the battery was connected to the dynamo; although the wind speed varied, it was not necessary to disconnect the battery, which sometimes received current from the dynamo and sometimes gave out current. At a wind

speed of 3 meters the battery was charged continuously. The test is said to have been very satisfactory.—*Elek. Anz.*, Sept. 23.

REFERENCES.

Motor-Driven Lathes.—An illustrated article on the different methods of driving lathes. While the most usual way is in groups, each lathe deriving its power through a countershaft off the main shafting, there are many cases where a motor to each lathe is suitable. The motor complete, with its own countershafting and cone pulley, may be fixed above the lathe; or it may rest on the ground and drive direct onto the cone pulleys; or a self-contained motor lathe may be used, the motor being fixed in the pedestal of the lathe. In the last case the necessary speed variations are obtained by a special gear, which is described and illustrated.—Lond. *Elec. Rev.*, Sept. 28.

Power Transmission.—ALIAMET and BRUNSWICK.—Continuations of their long serial (Digest, Sept. 15). In these parts they discuss the general features of synchronous and induction motors and describe the Boucherot motor. They further discuss the line loss in power transmission, give some notes on the compounding of alternators, and on motor generators, synchronous converters, frequency changers and phase transformers.—*L'Elec.*, Sept. 8, 22.

Power Generation.—J. B. C. KERSHAW.—The first part of his paper in full on the comparative cost of power generation by the steam engine, water turbine and gas engine, an abstract of which was noticed in the Digest Oct. 6.—Lond. *Elec. Rev.*, Sept. 28.

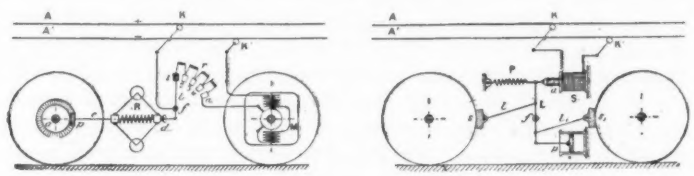
Utilization of Waste Heat.—A note stating that the three large German companies, the Siemens & Halske Company, the Union Company and the General Electric Company of Berlin, have founded a company for the exploitation of patents for the utilization of the waste heat of exhaust steam and condensing water.—Lond. *Elec.*, Sept. 28.

Electric Cranes.—EHNERT.—An article, in which he shows how to calculate an installation of an electric crane.—*Elek. Anz.*, Sept. 13.

Power from Blast Furnace Gas.—The first part of an article giving information regarding the generation of power by blast furnace gas.—Lond. *Elec. Rev.*, Sept. 28.

TRACTION.

Electric Traction for Mail Service.—An illustrated description of a system of electric traction, devised by Dubs and Laffitte, for transporting automatically and at high speed merchandise and light articles, such as letters, cards, etc. Automobiles are run on a double track, and are supplied with current from two overhead lines, by



FIGS. 1 AND 2.—ELECTRIC TRACTION FOR MAIL SERVICE.

means of sliding contacts; they are provided with automatic devices for starting and stopping, shown in the adjoining figures. Fig. 1 shows the starting device; when the circuit is closed the current goes from the positive feeder K through the starting resistances r to the motor M and to the negative feeder K'; when the motor is up to speed, the device, seen at the left hand of the diagram, is set into operation automatically; by means of the gearing p the motion of the wheel is transmitted to the axle e, so that centrifugal forces act upon the device R and the lever l which is pivoted in f cuts out gradually the starting resistances 1, 2, —n. The stopping device is seen in Fig. 2; as long as the circuit is closed, the electromagnet S, the coil of which is shunted across the feeders K and K', is excited and attracts the iron core a against the action of the spring P, the lever L, which is pivoted in f, releases by means of l and l_1, the brakes s and s_1; the breaking of the circuit thus applies the brakes. An automatic block system is used; the line is divided into several sections, and is arranged so that when a car runs on one section the next section behind it is automatically cut out. The inventors propose to use three-phase currents and induction motors on the cars.—*L'Eclairage Elec.*, Sept. 8.

Railway Power Transmission.—ARMSTRONG.—A paper read before the N. Y. State Street R'y Ass'n, in which he discusses the different systems of power transmission for traction purposes. A small, congested system, having its lines within easy reach of the power house, which enjoys good coal and water facilities, is distinctly a case for a 500-volt, direct-current system. Local conditions largely govern the use of boosters; generally it is not economical to operate them on continuous service, while for intermittent service on special occasions they are valuable. It is a matter for local consideration, whether a three-wire system should be used, with the track as a neutral, owing to the delicate balancing of the two sides of the circuit; such a system must necessarily require more care in laying out and more careful attention during operation than straight 500-volt distribution; but it may in certain cases afford sufficient advantages to warrant its adoption. For large systems, where the power generated is great and must be transmitted over considerable areas, alternating-current transmission with converter sub-stations may be preferable; the system possesses the great advantage of being perfectly flexible and adapted for future growth or extension. A train propelled by induction motors presents some novel characteristics; the speed of the train is fixed not by the voltage of the trolley, as in the direct-current system, but by the frequency of the source of supply, which offers a much surer guarantee of maintaining a fixed schedule speed; the induction motor has special advantages which should warrant its adoption on long trunk lines with infrequent travel, the main benefit being the low cost of installation and of operation; the induction motor system appears best adapted for the operation of long suburban roads having no city connections, and especially those roads where heavy trains operate at infrequent intervals.—*Street Ry. Jour., Elec. Rev.*, Oct. 3.

REFERENCES.

International Tramway Congress.—An account of the proceedings of this congress, which was held in Paris Sept. 10 to 13, with abstracts of the following papers: Geron spoke on tariffs; the introduction of a cheap tariff and of a single rate have given excellent results in the given unfavorable results on suburban lines; statistical data are given centre of thickly populated cities, while a single rate has sometimes for several cities. De Pirch read a paper on the advantages of the trolley system over animal and locomotive traction; the different advantages are discussed and some statistical data are given. Gunderloch read a paper on the advantages and inconveniences of normal gauge and meter gauge roads. Thonet and D'Hoop read a paper on the installation of a central station, in which they gave a summary of the replies obtained to a set of questions from 16 central stations.—*L'Eclairage Elec.*, Sept. 15.

Storage Batteries for Short Roads.—VAN NOSTRAND.—A paper read before the N. Y. Street R'y Ass'n, in which he describes the installation of the Peekskill Lighting & Railroad Company plant, as a proof that storage batteries are very well adapted also for small lines.—*El'ty*, Oct. 3.

Accessories of Electric Traction.—COTTRELL.—The conclusion of his very long serial (Digest, Sept. 15), dealing with the overhead line construction of the trolley system.—Lond. *Elec. Rev.*, Sept. 28.

Graz.—POSCHENRIEDER.—A long, well-illustrated article on the changing over of the tramways of Graz, Austria, from horse traction to the trolley system.—*Zeit. fuer Elek.*, Aug. 26, Sept. 2.

Single-Rail Express Railway.—BEHR.—A reprint of his paper on the brakes and signals of the proposed Manchester and Liverpool railway, noticed in the Digest Oct. 6.—*El'ty*, Oct. 3.

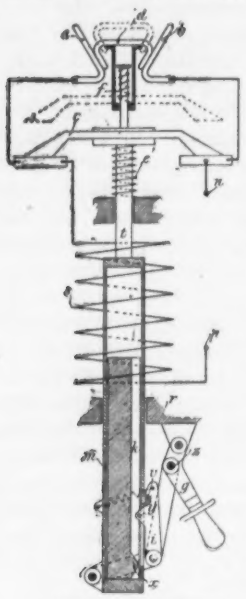
Automobile.—MONTEL.—A mathematical paper, in which he develops formulas for the determination of the motive power required by an automobile.—*L'Eclairage Elec.*, Sept. 8.

Viagraph.—A note on a B. A. communication, describing an instrument devised by Brown for testing and recording automatically the unevenness of the surface of roads and streets.—Lond. *Elec. Eng.*, Sept. 28.

Austria.—A table of the traffic and the receipts of the electric railways of Austria and Bosnia during April, May and June, compared with those of 1899.—*Zeit. fuer Elek.*, Sept. 2.

Automatic Circuit Breaker.—MUELLER.—An illustrated description of an automatic interrupter, made by Shuckert & Company; it breaks the circuit when the current exceeds a certain limit; should the circuit be then closed again by means of the hand-lever, it is broken at once by the automatic device in case the current is still above that limit. The interrupter is illustrated in the adjoining figure; p and n are the terminals of the circuit; the current goes from p through coil s and the two branches c and a d b in parallel to n; c and d are the pieces by which contact is made and broken; the straight lines represent the circuit when closed, the dotted lines when open. To bring the pieces c and d into the position marked by dotted lines, the tubes m and t can move upwards; the spring e always tends to move the tubes m t upwards and to break the circuit; the tubes m t are, there-

fore, held down by means of the click *v* against the upper nose of the lever *i*. If it is intended to break the circuit by hand, it is sufficient to raise the lever *g*, so that the click *v* is released. For automatic interruption, an iron core *k* is loosely contained in the tube *m;* when the current in the coil *s* exceeds the allowed limit, the core *k* is attracted and its nose *x* releases the leved *L'* by means of the nose *y*. The circuit is always broken first by *c* and finally by *d*. If the automatic device has worked and the circuit is broken, the interrupter is reset by first moving the hand lever *g* upwards, so that the upper nose of *i* arrests again the click *v*, and by further moving the hand lever *g* down to the position shown in the figure.—*Elek. Zeit.*, Sept. 27.



AUTOMATIC CIRCUIT BREAKER.

Argentina. — Danvers. — A paper read before the Inst. of Eng. of the River Plate, on electricity in Argentina. Electrical enterprise has received great impetus in that country during the past three years, and there is still a large field open to it, but it is greatly hampered by taxation, which is said to be out of all proportion to the advantages conceded by the authorities. There are large tracts of mining territory awaiting the development of electric power stations. The telegraph system of Argentina includes the national, provincial, railway and private companies' lines. The telephone system throughout the country is in the hands of private enterprise, and not under governmental or municipal control. Buenos Ayres is lighted at present by 702 arc, 13,445 gas, and 8307 kerosene lamps. There are 26 direct-current and 8 alternating-current stations in the country, with a total output of 21,000 horse-power. In Buenos Ayres there are at present four public companies, one private firm, three municipal and two government stations supplying light for public and private use. The Stone system of train lighting is largely in use on the railways. The total capital employed in electrical enterprises in Argentina at present is $39,000,000 in gold.—Lond. *Elec. Rev.*, Sept. 28.

Glasgow.—The conclusion of the long, well-illustrated article on the new central station in Glasgow. This part gives a description of the street work and the main cables. The feeders and distributors are triple concentric cables, insulated with resinous paper, vulcanized bitumen, or impregnated jute, and all except the vulcanized bitumen cables are lead-covered. They are laid in iron, earthenware, or wooden troughs, and are filled in solid with a composition of the best coal tar, pitch and asphalt oil. On the three-wire system the core of the cable is positive, the centre conductor negative, and the outer conductor neutral. The sheathing of all lead-covered cables entering the station is bonded to earth plates at the station.—Lond. *Elec.*, Sept. 28. Continuations of other illustrated descriptions of this plant in Lond. *Elec. Rev.* and *Elec. Eng.*, Sept. 28.

Electric Plants for Small Towns.—Boot.—A paper on "Electricity supply for lighting and tramways, with special reference to small towns." He speaks strongly in favor of one combined lighting and traction plant, and recommends considering the erection of a refuse destructor in combination with the plant; he gives some data about refuse destructors. He discusses the selection of a site and of the best system, and makes some remarks regarding the water supply. The only fair and equitable way of charging for electricity is said to be based upon the maximum demand system; as an instrument for ascertaining the maximum demand of each consumer he uses a hermetically sealed tube, containing air and a liquid, a conductor of short length and of slightly higher resistance than copper; current passing through the conductor generates heat, which expands the air inside the tube and forces a portion of the liquid up to the tube adjoining, where it remains permanently, until it is reset by the meter inspector. He recommends encouraging the development of a motor load in a manufacturing town, and says that it is important for towns undertaking electricity supply to commence with a thorough system of public lighting, and to light the whole of the district either by arc or by incandescent lamps along the line of route in which the cables are laid; the mains should be laid well in advance of the demand.—Lond. *Elec. Eng.*, Sept. 28.

Gautzsch.—An illustrated description of the electric plant of Gautzsch, a small village near Leipzig, Germany. The current is furnished to some cottages for supplying 450 incandescent lamps, 2 arc lamps and 3 motors of together 1 horse-power, the two-wire system at 220 volts being used. There are two dynamos of together 20 kilowatts, driven by a gas engine, and a storage battery of 122 cells, with a capacity of 201 ampere-hours, if discharged in 3 hours.—*Elek Anz.*, Sept. 13.

REFERENCES.

Electric Light and Power in Theatres.—Mornat.—A paper read before the Internat. Elec. Congress on the danger of fire from electric installations in theatres. He discusses the danger arising from bad contacts and from careless installation of electric cables in damp places and near gas and water pipes, and gives his views about proper electric installations in theatres.—*L'Eclairage Elec.*, Sept. 8.

Generating Stations.—Gibbings.—A brief abstract of a paper on "The design and location of electric generating stations." He claims that a lighting plant should always be constructed and located with a view to include the supply of energy for motive power, tramways and electrochemical purposes.—Lond. *Elec.* and *Elec. Rev.*, Sept. 28.

Nancy.—An illustrated description of the electric light station of Nancy containing a set of two multipolar dynamos, direct-driven by the same engine; each dynamo gives 620 amperes at 250 volts.—*L'Eclairage Elec.*, Sept. 8.

Regulating Resistances.—Hunke.—An article in which he describes a graphical method of calculating resistances used for regulation purposes. The article is fully illustrated with diagrams.—*Elek. Zeit.*, Sept. 27.

Electrical Contacts.—Mason.—A paper read before the Internat. Ass'n of Munic. Eng. He shows how chemical action and dirt always tend to destroy efficient electrical contact, and points out how soldered joints, binding posts, fuses and the working contacts of electrical instruments should be made.—*Elec. Rev.*, Oct. 3; *West. Elec.*, Oct. 6; *El'ty*, Oct. 10; Elec. World and Eng., Oct 6.

A New Method of Charging for Electric Current.—DeFodor.—His paper in full, read before the Internat. Elec. Congress and abstracted in the Elec. World and Eng., Sept. 15, p. 412.—*L'Eclairage Elec.*, Sept. 15.

Wires, Wiring and Conduits.

Interior Wiring.—Allingham.—An article in which he says that the concentric system of wiring with uninsulated outer has certain advantages, if only the wiring of the building by itself is considered, but these advantages are not peculiar to this system. On the other hand, if the distributing system as a whole, from the station to the lamps, is considered, the use of uninsulated return conductors is open to many objections; the property that any fault is bound to become a dead short circuit; is a serious disadvantage in a large distributing system; on a large network different parts even of the middle wire of a three-wire system may be at considerably different potentials, so that from uninsulated returns electrolytic troubles may arise. The principal advantage usually claimed for concentric wiring is its safety; he says that in this respect any metal-sheathed system of wiring with both conductors insulated has the same advantage, provided that the metal-sheathing is made electrically continuous throughout, and is sufficiently earthed, and that one of the wires is earthed at one point either continuously or at frequent intervals. He thinks that the greatest possible safety in house wiring would be obtained by using double wiring, enclosed throughout in earthed metal-sheathing, connected to three-wire mains having a removable earth connection on the middle wire at the station, and by earthing each of the outers—while the middle wire is temporarily disconnected from earth—for a minute or so regularly every day. Any fault in a consumer's installation on either of the outers would instantly cut itself off, and any fault on the neutral would cut itself off the next time the outers were earthed at the station, so that the consumer's wiring would be perfectly "self-testing," just as concentric wiring is, and at the same time it would be free from the objections to concentric wiring. The recently introduced system of wiring in steel conduits with sleeve joints has the great disadvantage that the sleeves do not make a good electrical connection. The requisite conditions may, however, be fulfilled by the use of iron or steel tubes with screwed couplings or by lead-covered wires. He thinks that lead-covered wires with fibrous insulation are likely to come into use very much more for house work in the near future, and calls attention to their advantages.—Lond. *Elec. Rev.*, Sept. 28.

REFERENCES.

Cables.—A note giving some information on submarine cables, made by the Gen. Elec. Co. of Berlin, for exploding mines.—*Zeit. fuer Elek.*, Sept. 23.

Extra Current.—JOHNSON.—An abstract of a paper on the extra current due to breaking a circuit which contains an induction coil, a cell, an interrupter and a condenser in shunt with the interrupter. He supposes that the discharge of the condenser is oscillating, and calculates the maximum potential difference between the plates of the condenser; the formula found shows that this maximum potential difference is the smaller, the greater the capacity of the condenser. The greater the capacity, the smaller is the liability to sparking when the circuit is broken; this is in agreement with experiments. When a spark occurs, the phenomenon becomes very complicated.—*L'Eclairage Elec.*, Sept. 15.

Cathode Rays.—BATTELLI AND STEFANINI.—An account of an experimental investigation of the velocity of cathode rays and the electric conductivity of gases. They found a speed of 60 kilometers per second for a pressure of a gas equal to 0.005 mm. of mercury and a potential drop of 25,000 volts; also a velocity of 120 kilometers per second for 0.001 mm. of mercury and 120,000 volts. From their experiments they conclude that the luminous phenomena in the cathode rays are not produced by the particles which transport the electricity; also that electric discharges through gases are associated with important chemical modifications, such as ionization.—*Nuovo Cimento*, November, '99; abstracted in *L'Eclairage Elec.*, Sept. 15.

Ions.—An abstract of a joint Brit. Ass'n discussion on "Ions." It was opened by FitzGerald, who mentioned some difficulties which he has found in the usual theories of ions for the explanation of electrolytic phenomena; he spoke on the electric conduction in gases, and suggested that the term ionization should be used only to denote that charged atoms exist, and that the word electronization should be employed to denote the state of a gas acting as a conductor in which there are free electrons; probably both ionization and electronization occur in a gas; he suggested various experiments for elucidating uncertain problems. Larmor, Wetham, Lodge and Armstrong participated in the discussion; the latter remarked that "the German schools were so fixed in their ideas that a discussion with them was absolutely impossible."—Lond. *Elec. Eng.*, Sept. 28.

REFERENCES.

Vector Potential of Currents.—BURBURY.—An abstract of a mathematical Brit. Ass'n paper "On the vector potential of electric currents in a field where disturbances are propagated with finite velocity."—Lond. *Elec.*, Sept. 28.

Multiple Space.—CARSLAW.—An abstract of a Brit. Ass'n paper on "The use of multiple space in applied mathematics." In certain problems in electrostatics, electric conduction, etc., where the ordinary method of images fails, a Riemann's surface may be used, and with the help of a multiple space the problems can be solved by images. The paper is purely theoretical.—Lond. *Elec.*, Sept. 28.

Cathode Rays.—PHILLIPS.—A reprint of his paper on the apparent emission of cathode rays from an electrode at zero potential, noticed in the Digest Oct. 6.—*Elec. Rev.*, Oct. 3.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Copper Wire Bars.—An illustrated article on Emerson's method of making electrolytic copper wire bars. The object of the invention is to produce, by electrolysis, bars that are adapted to be drawn into wire directly from the unrefined metal. A spiral strip of a metal is first produced by electro-deposition on a cylindrical cathode; it is then removed from the cathode and wound spirally on a cage suspended in a depositing tank so as to expose all the surface of the strip of metal, and the sectional area of the strip is then increased by electro-deposition until a bar of sufficient size is produced, which may be rolled or drawn into wire.—*Eng. and Min. Jour.*, Oct. 6.

REFERENCES.

Galvanic Cells.—COOPER.—The first part of a paper on "The osmotic pressure theory of primary cells." He gives an outline of the laws of osmotic pressure and develops Nernst's formula for the e. m. f. between an electrode and electrolyte, based upon the theory of the electrolytic solution pressure.—Lond. *Elec.*, Sept. 28.

Dry Cells.—LIEBENOW.—An article in which he shows that the so-called dry accumulators have very serious disadvantages which are inherent in their general construction and therefore cannot be overcome under any conditions. (See the abstract of his German paper in the Digest, April 28.)—*L'Elec.*, Sept. 15.

Electrolytic Depositions of Metals.—BOUILHET.—An abstract of a paper read before the Internat. Elec. Congress. He gives some notes on the electrolytic deposition of several metals, and also statistical data regarding the electrolytic production of silver, gold, copper and nickel, in the different countries.—*L'Eclairage Elec.*, Sept. 15.

Electrolysis of Water.—SCHOOP.—An illustrated article on the commercial production of hydrogen and oxygen by electrolysis, with special reference to the use of gas for soldering purposes. He describes several forms of electrolyzers, especially his own.—*Zeit. fuer Elek.*, Sept. 9.

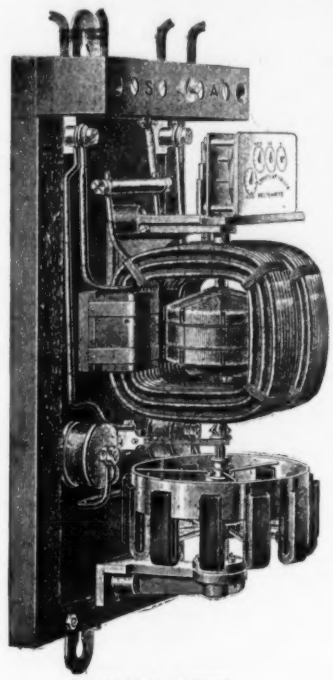
Cleaning of Metallic Surfaces.—A German article on the method of the United Elec. Co., of Vienna, a French description of which was abstracted in the Digest Oct. 6.—*Elek. Anz.*, Sept. 13.

Small Storage Batteries.—HAERDEN.—An illustrated article showing how to make a small storage battery for lighting show windows, operating electric bells, etc.—*Elek. Anz.*, Sept. 20.

Aluminum.—J. A. STEINMETZ.—A Franklin Institute paper discussing the general application of aluminum in the arts and mechanics.—*Jour. Frank Inst.*, Oct.

UNITS, MEASUREMENTS AND INSTRUMENTS

Vulcan Meter.—HOPFELT.—An illustrated description of the Vulcan meter which is made by a French company and is said to enable an exact and simple adjustment to be made in one or two minutes. The meter is shown in the adjoining figure, and is constructed like an ordinary motor meter; the principal difference lies in the arrangement of the brake device. There are twelve small magnets, arranged in a circle, with their poles on both sides of a ring of copper. For making a quick adjustment of the constant, the magnets are mounted on a brass star, which is supported by a vertical screw, so that the magnets may be easily raised or lowered, by which the braking force is increased or diminished.—*Elek. Anz.*, Sept. 27.



VULCAN METER.

Standard Resistances and Resistance Boxes.—EDELMANN.—An illustrated article giving practical rules for making standard resistances and resistance boxes. For the resistance coils, manganine should always be used; he gives some hints as to its treatment. Manganine is well protected against atmospheric influences by a coat of shellac. He recommends using seasoned maple wood for the cores of the resistance coil. A resistance coil is best made of two parts; the main coil, the resistance of which is somewhat higher than the nominal value of the resistance, and a smaller one for correction purposes, both coils being, of course, in parallel. In making the correction, great care should be taken not to bring the whole resistance below the nominal value, as the adding of wire generally causes inconstance of the resistance. He recommends making resistances which are to be kept in stock a little above their normal value, and not making the last corrections until they are sold. The resistances are made constant in a steam bath. In a resistance box the ends of two consecutive coils which are connected totgether by the contact piece of brass at the top of the box, should be connected separately to this contact piece. For the plug keys he does not recommend stoppers with rubber handles, as good contact is rarely obtained by them; he recommends, instead, inserting and removing them by means of a key like that used for tuning a piano. He found that with 30 plug keys 7 mm diameter, in series, the variations in the resistances are not above 0.00003 ohm, or not above 0.000005 ohm with plug keys of 14 mm. The resistance of the contact brass pieces with all 30 plug keys inserted was found to be about 0.00132 ohm, so that if all resistance coils are correctly calibrated, all the readings are too small by this value. To allow an easy correction, he adds a resistance of thick manganine wire in series with the brass blocks, so that the whole resistance of the contact brass pieces, with all plug keys inserted, becomes 0.005 ohms; the corrections are then easy.—*Elek. Zeit.*, Sept. 27.

Volt and Ammeter.—BAILY.—A brief illustrated abstract of a Brit. Ass'n paper on "A lecture room volt and ammeter." He has made

an arrangement of resistances and connections in a small portable box for using the d'Arsonval galvanometer as a volt and ammeter. As a voltmeter it is used in series with a large resistance, and it is shunted to obtain variations in scale. For use as ammeter the connections are those used in potentiometer work and two calibrated resistances are provided, through one of which the current to be measured is passed. —Lond. *Elec. Eng.*, Sept. 28.

Determination of Magnetic Force.—A brief abstract of a committee's report to the Brit. Ass'n for determining the magnetic force of the earth on board ship. The greatest difficulty is due to variations in the strengths of the magnets used. A method devised by Creak is recommended by which this difficulty is overcome. Two magnetic needles are used and the experiments consist in finding out the alteration in readings given by adding weights to the needles. The variation of the magnetic moment of either of the needles is eliminated by a third measurement by observing the deflection caused by one needle on the other.—Lond. *Elec. Eng.*, Sept. 28.

REFERENCES.

Photometry.—VIOLLE.—His long paper in full, read before the Internat. Elec. Congress and abstracted in the ELEC. WORLD AND ENG. Sept. 15, p. 413.—*L'Eclairage Elec.*, Sept. 15. An English translation in abstract of this paper, also an editorial on "The measurement of light," in Lond. *Elec.*, Sept. 28.

Aron Meter.—Two communications, with a sketch, describing how to test the Aron new model watt-hour meters for alternating current at ordinary periodicity.—Lond. *Elec. Eng.*, Sept. 28.

Holden Meter.—REYVAL.—An illustrated description of the Holden meter shown at the Exhibition and described in the Digest Sept. 15.—*L'Eclairage Elec.*, Sept. 15.

Wattmeter and Maximum Demand Indicator.—BARKER.—*A* reprint of his paper, noticed in the Digest Sept. 29.—*El'ty*, Oct. 3.

Switchboard Instruments.—BAXTER.—A continuation of his illustrated serial (Digest, Oct. 13). This part deals with recording ammeters, voltmeters and wattmeters.—*Amer. Mach.*, Oct. 4.

TELEGRAPHY TELEPHONY AND SIGNALS.

Wireless Telegraphy.—MINOLTZ.—A fully illustrated description of the first German stations for wireless telegraphy, which have been erected on the island of Borkum, as noticed in the Digest June 23. The chief purpose is to transmit messages from the arriving North German Lloyd steamers to the coast. Wireless telegrams are also sent from the fireship at Borkum Riff to a lighthouse on the island of Borkum over a distance of 24 miles. The Marconi system is used. On the lighthouse two vertical wires were used at first, but better results are now obtained with a wirework of 20-meter length and 1-meter breadth. The service is, in general, satisfactory, and sometimes very good. In one case a message was received from the Lloyd steamer Kaiser Wilhelm der Grosse over a distance of 57 miles. The Marconi apparatus used is described in detail and illustrated.—*Elek. Zeit.*, Sept. 27.

REFERENCES.

Telephone Switchboards.—CLAUSEN.—A continuation of his serial (Digest, Sept. 8). In this part he gives a set of general specifications of switchboard and telephone equipment and discusses the general office installation and equipment.—*Tel. Mag.*, Sept.

Philippines.—RICE.—An illustrated article on telegraphy in the Philippines.—*West. Elec.*, Sept. 22.

Burglar Alarm.—An illustrated description of a burglar alarm for safes, made by a German company.—*Elek. Zeit.*, Sept. 20.

Electric Pendulum.—DARY.—An illustrated description of the Campiche electric pendulum, which seems simple and is said to be very precise in its action.—*L'Elec.*, Sept. 22.

MISCELLANEOUS.

REFERENCES.

International Electrical Congress.—A very long summary, covering 20 pages, of the proceedings of the Congress.—*L'Ind. Elec.*, Aug. 25.

International Congress for Applied Chemistry.—BLONDIN.—A full account of the proceedings, with abstracts of the papers read. As far as they are electrical, they are noticed in the Digest under Electrochemistry.—*L'Eclairage Elec.*, Aug. 4, 11, 18.

Work of International Congresses.—HOSPITALIER.—A report, made to the recent International Elec. Congress in Paris, giving a summary of the decisions of former congresses.—*L'Eclairage Elec.*, Aug. 18.

Pan-American Exposition.—PERKINS.—An illustrated article on electrical attractions at the Pan-American Exposition of the coming year.—*West. Elec.*, Oct. 6.

Electric Furnaces.—KELLER.—His paper in full, read before the Internat. Elec. Congress and abstracted in the ELEC. WORLD AND ENG., Sept. 15, pp. 412 and 400.—*L'Eclairage Elec.*, Aug. 25.

Galveston.—KNIGHT.—An illustrated article on electrical apparatus destroyed by the Galveston flood.—*Elec. Rev.*, Sept. 26.

Current Generation for Therapeutic Uses.—CHILD.—A paper read before the Amer. El. Therap. Ass'n on the methods of generating and transforming electric currents for therapeutic uses. He discussed the use of the Voltaic cell, the dry cell, the storage battery, the static induction machines, the induction coil and the rotary converter.—*Elec. Rev.*, Oct. 3.

Paris Exposition.—HORNER.—An illustrated article on machine tools, cranes, boilers and engines at the Exposition.—*Cassier's Mag.*, Oct.

An illustrated article on a Hutin & Leblanc direct connected two-phase alternator.—*West Elec.*, Sept. 29.

LAFFARGUE.—An illustrated article on electric machines exhibited. —*La Nature*, Sept. 22.

A summary of the awards given in the electric classes.—*L'Ind. Elec.*, Aug. 25.

REYVAL.—An illustrated description of the Heinz storage battery and the Omega battery.—*L'Eclairage Elec.*, Aug. 4.

REYVAL.—Illustrated descriptions of a steam-driven 800 kilovolt-ampere three-phase alternator, exhibited by the company de Fives-Lille; of storage batteries exhibited by the Société pour le Travail Electrique des Metaux; and of an electric locomotive for main lines, exhibited by the Gen'l Elec. Co., of Berlin.—*L'Eclairage Elec.*, Aug. 18.

ARMAGNAT.—A long, well illustrated description of laboratory instruments exhibited in the German section.—*L'Eclairage Elec.*, Sept. 1.

An illustrated description of thermometers and pyrometers of Hartmann & Braun.—*L'Elec.*, Aug. 18.

A description of the exhibit of the John A. Roebling's Sons Co.—*Eng. and Min. Jour.*, Oct. 6.

LAFFARGUE.—An illustrated article on the "Centennial electrical museum," containing 249 old apparatus and 210 books, exhibited by Sartiaux.—*La Nature*, Sept. 29.

PRASCH.—An illustrated article on a signal system for telephone lines, exhibited by Leopolder & Son, of Vienna.—*Zeit. fuer Elek.*, Sept. 9.

An illustrated article on exhibits in the class of electric lighting.—*Elek. Anz.*, Sept. 16.

BORCHERS.—Continuations of his long serial (Digest, Sept. 15), on electrochemical and metallurgical exhibits. He deals with the mineral products of Hungary, Germany, the Transvaal and the United States; the United States, he says, "sent one of the richest and most interesting exhibits of useful minerals" to Paris. He describes at some length the exhibits of models and plans of water power plants and deals more briefly with steam engines and gas engines.—*Zeit. fuer Elektrochemie*, Aug. 30, Sept. 6, 13.

MONTPELLIER.—An illustrated description of a steam-driven 280-kw direct current generator, exhibited by the Société des Hauts-Fourneaux de Maubeuge.—*L'Elec.*, Sept. 15.

MONTPELLIER.—An illustrated description of an "electric calorifactor," exhibited by Ougrimoff. It is a small boiler in which the heat for evaporating the water is produced by an electric arc. It is intended to be used in hydraulic power stations where steam is required for heating.—*L'Elec.*, Sept. 22.

A brief illustrated description of the Langen suspended single-rail road.—*Sc. Amer.*, Oct. 6.

DURAND.—Illustrated descriptions of various metallurgical and electrochemical exhibits; Lord Kelvin's instruments, and the U. S. retrospective exhibit.—*Elec. Rev.*, Oct. 3.

JAULIN.—An article on the mail, telegraph and telephone service at the exposition.—*Jour. Teleg.*, Sept. 25.

A description of direct current generators, exhibited by the Belfort and the Decanville companies.—*El'ty*, Oct. 3.

The seventh part of the well-illustrated serial. This part deals with French alternators, especially those of Hutin and Leblanc.—Lond. *Elec.*, Sept. 28.

An illustrated description of machines exhibited by J. J. Reiter & Company, of Winterthur.—Lond. *Elec. Rev.*, Sept. 28.

An illustrated description of a standard-gauge electric locomotive exhibited by the General Elec. Co., of Berlin.—Lond. *Elec. Eng.*, Sept. 28.

New Books.

BOOKS RECEIVED.

DYNAMO ELECTRIC MACHINERY. Its Construction, Design and Operation. Direct current machines. By Samuel Sheldon, A. M., Ph.D., assisted by Hobart Mason, B. S.; D. Van Nostrand Company, New York: 280 pages, illustrated. Price, $2.50, net.

STATISTICS OF RAILWAYS IN THE UNITED STATES. 1899. Interstate Commerce Commission. Twelfth Annual Report, prepared by the Statistician to the Commission. Washington: Government printing Office. 711 pages.

New Direct Current Dynamos and Motors.

The Three Rivers Electric Company, of Three Rivers, Mich., has made a very promising start as manufacturer of direct current dynamos and motors. The design and construction is under the supervision of Messrs. Geo. and John F. Card (formerly with the Card Electric Company, Mansfield, Ohio), who are well known in this field of work.

The machines illustrated in Figs. 1 and 2 are called E type, and range from 5 horse-power to 50 horse-power, with the usual intermediate sizes, and are wound for all standard voltages, both as dynamos and motors. As to their make-up and performances, the claims of the company in its recently issued catalogue are as follows: "The efficiencies of all modern machines built by reputable makers

FIG. 1.—E TYPE MOTOR OR DYNAMO.

are practicaly alike. There can be no great difference, since the dimensions and weight for any given output in properly designed machines are always within a close range, and the heat losses are limited by custom to a certain rise in temperature above the surrounding atmosphere. The best quality of material can be bought by any one and the manipulation of stock in all factories is much the same. We use the best material we can purchase, work it up in the most approved manner and claim for our machines as high efficiencies as can be obtained without impairing their durability. We make special claim to a high commercial efficiency, by which we mean capacity to do work through a period of time at a minimum cost, including repairs and the time lost in making them."

Attention is called to the method of supporting the brush holders (illustrated in Fig. 2), which is unusual for machines of such small size, and is considered a decided mechanical improvement over the common practice of supporting the brush rocker on the pedestal or yoke outside the commutator. It also gives the machine a neat appearance when direct connected to the prime mover. The armature

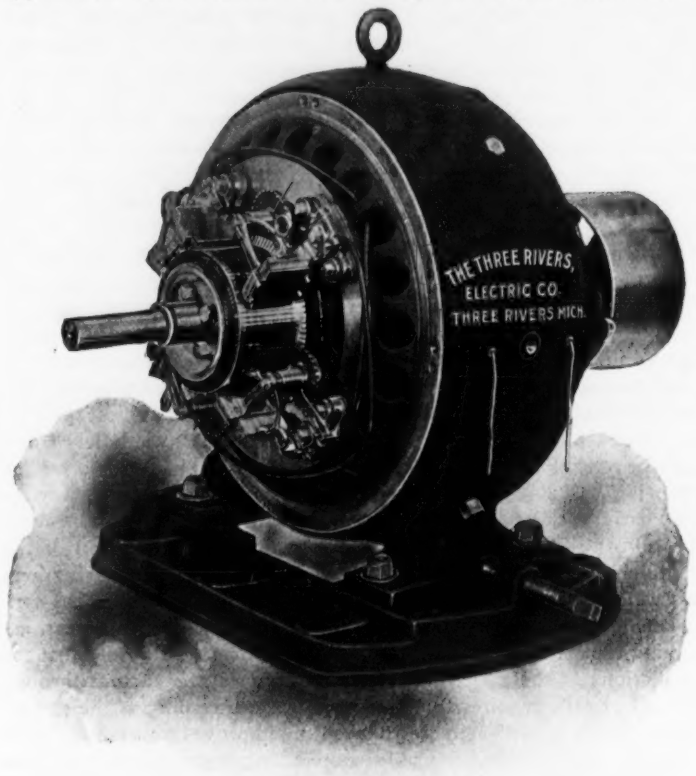


FIG. 2.—METHOD OF SUPPORTING BRUSH HOLDERS.

coils are form wound and the cores are made to satisfy the most rigid requirements as to permeability and ventilation. The pole pieces are built up of soft steel laminations joined to the pole ring in a special manner to make perfect contact, and every part is fitted together with steel rings, plugs and jigs, insuring perfect interchangeability.

These motors are adapted for mounting on the ceiling or wall for machine driving, and have, it is said, some special advantages for this class of work which the company would be pleased to explain to those interested.

A New Edison Electrolytic Meter.

Following up his familiar work in the field of electrolytic meters, Mr. T. A. Edison has recently taken out a patent on another variety of this species. He says that it is accurate in registration, can be easily and instantly read, is not liable to derangement in use or transportation and works on a minimum of current.

Underlying the present invention is an improved electrolytic cell, which can be absolutely standardized and which in a stationary temperature will always maintain a constant resistance, so that the rate of deposition will be uniform. This improved cell is provided with two electrodes, of pure zinc or zinc amalgam, immersed in a solution of sulphate of zinc in distilled water. Other electrodes may be employed. In order to prevent evaporation of the solution and any tendency thereof to creep, and to thereby maintain the absolute uniformity of the solution, Mr. Edison covers the solution with a stable inorganic non-miscible liquid, such as mineral oil, of which paraffin oil is the preferred example. Having produced an electrolytic cell of this character which will be entirely unaffected by evaporation and which will always be possessed of a uniform rate of deposition, he connects one or two of such cells around a relatively low resistance, whereby a minute but definite and constant ratio of current will affect the cell or cells, and obtains by the deposition from one electrode to the other and by positive mechanical devices an accurate registration, capable of

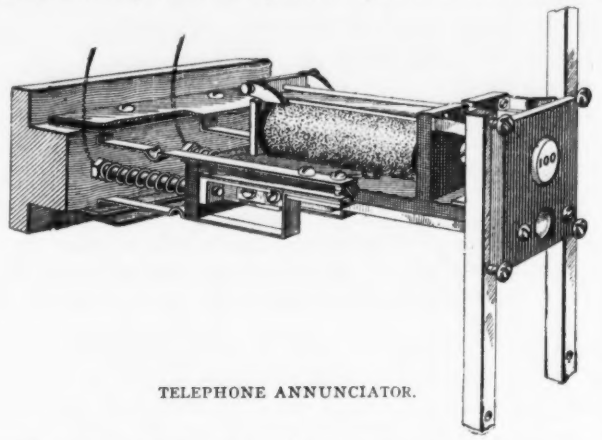
easy reading, of the total current. To this end he attaches the movable electrodes of two cells to the two extremities of a scale-beam supported on knife edges or other relatively frictionless support, the electrical connections being such that while the metal is being deposited upon the movable electrode of one cell it will be stripped off of the movable electrode of the other cell, whereby the scale-beam will tend to move downward toward the heavier movable electrode. If desired, however, a single cell may be employed, connected to one extremity of the scale-beam, a counter-weight being connected to the other extremity thereof. The beam is connected with a suitable retarding device, which opposes the stress exerted by either of the movable electrodes of the two cells on which the deposit is taking place. In this way the scale-beam, under the effect of the depositing and stripping of the metal, will partake of an extremely slow movement in one direction or the other, the extent of such movement being constant, but its relative slowness depending upon the current influencing the cells. The retarding device for opposing the movements of the beam is a weight carried on an arm depending from the beam in line with the pivot thereof, which weight may be adjustable vertically, whereby its opposing effect may be adjusted and by means of which, also, the capacity of the meter may be varied. The oscillations of the scale-beam actuate an escapement controlling a registering train, which operates a suitable pointer or pointers of a dial or dials. The connection between the scale-beam and escapement is of a novel character, and is such that friction is so infinitely small as to be negligible. The registering train is driven either by a weight or spring, and since the release of the escapement takes place very infrequently, even when currents of considerable volume are influencing the cell or cells, it will be possible to obtain a sufficient fall of the relatively light weight as to require winding thereof only during long intervals of time. For example, in meters which Mr. Edison has constructed, the fall of the weight is approximately 2 ins. in a year, assuming the meter to be carrying its maximum load. In order that the oscillations of the scale-beam may be produced, the current through the cell or cells requires to be reversed at each tripping of the escapement, and Mr. Edison has produced an improved reversing switch wherein only a single movable contact is required, such reversing switch being operated directly by the register train and therefore imposing no stress upon the scale-beam. To prevent oxidation of the parts comprising the current reversing devices, he plates the contact surfaces thereof with gold or some other non-oxidizable metal.

The elements of the meter are carried on an insulated board within any convenient meter box having a glass front, through which the dials may be observed. When used in localities where low temperatures may be expected, it is desirable to employ a heating device brought into circuit by means of a thermostat if the temperature falls dangerously near the freezing point of the liquid in the cell. Such a heating device is preferably an incandescent lamp arranged in a branch circuit across the line and in series with a thermostatic bar composed of two metals having unequal coefficients of expansion. In order that changes in temperature, which necessarily affect the resistance of the cell or cells, may not result in incorrect registration, Mr. Edison interposes in series with the cell or cells an ordinary compensating coil, the resistance of which changes inversely with that of the cell or cells, whereby the resistance of the shunt including the cell or cells and said compensator will be always maintained constant, irrespective of changes in temperature.

An Inward-Falling Telephone Annunciator.

Mr. C. T. Mason, of Sumter, S. C., has taken out a patent on an improvement in telephone switchboard annunciators and jacks, worked out in detail so as to afford all the requirements of a single circuit or a metallic system exchange. A special and specific feature of his invention is the drop-shutter falling inwardly, which he considers is a decided improvement over all outward-falling shutters. In the first place, it cannot be thrown by accidental contact with the operator's hand, plug or cord while operating the board in answering calls and establishing connections. The clicker or shutter-catch holding the shutter in its restored position is protected by the shutter falling inwardly, inasmuch as it is concealed behind the shutter and drop-front, thus entirely eliminating the possibility of the shutter being thrown by any other than its normal means. The inward-falling shutter has a further advantage in that the shutter-hinges and other parts requiring careful and permanent adjustment are protected against the liability of being damaged or rendered out of adjustment, as the shutter is shielded behind the drop-front, and not exposed to the danger of being knocked, twisted and damaged, as is the case with the outward-falling shutter. In the combination covered by the invention, all "listening-in" and ringing cams or switches in the connecting cord circuits may be done away with.

Mr. Mason's patent further covers the inwardly-falling drop-shutter mechanically restored by the point of the plug, the shutter being made with an extension or tail below its pivoted part, so that this extension of the shutter shall pass into the jack itself, the shutter being so formed and arranged that its extension or tail while the shutter is down shall be in the jack-throat and not overhanging it, so that the point of the plug, immediately upon entering the jack, restores the shutter during the first part of its entering movement. Another point is that the shutter falls inwardly and the tail or extension of the shutter extends, when fallen, into the jack and does not overhang



TELEPHONE ANNUNCIATOR.

the throat, nor does it require any cam shape or special construction of the plug or plug-handle or intermediate springs or devices to restore the shutter, all of which for many practical reasons are not desirable. Only an ordinary form of plug or plug-handle is required, as any plug that will enter the jack will restore the shutter, owing to the distinctive provision of the tail of the shutter entering or falling into the throat of the jack while the shutter is down in its inwardly-fallen position. The tail of the shutter employed is thus simply a part of the shutter and not an attachment to it.

A further advantage claimed is that the "bull's-eye" signal projection, which is an attachment to the shutter, projecting through a perforation in the rubber front, makes a very conspicuous signal, and easily detected when it disappears by the shutter falling inwardly, even when viewed at an angle.

Two Christmas Motors.

The accompanying illustrations show two Christmas novelties manufactured by Messrs. Kendrick & Davis, Lebanon, N. H. The Rex motor (Fig. 1) is constructed after the style of the other Porter motors made by this firm. It has a well-balanced three-pole arma-

FIG 1.—REX MOTOR.

FIG. 2.—AJAX MOTOR.

ture, which runs true and smoothly on a cast-steel shaft. The fields are of good magnetic proportions, and otherwise the motor is well fashioned. It surmounts a polished wooden base. This motor, it is stated, will run at a speed of 4000 r. p. m. on one cell of dry battery.

The Ajax motor (Fig. 2) is neatly designed, well made and handsomely finished. It attains a high speed on one or two cells of dry battery.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed nominally at 2½@3 per cent. Time money during the week was freely offered, notwithstanding the volume of withdrawals of funds from this centre for the movement of crops. The rates are 5 per cent for all periods of time. There was little movement in mercantile paper. Rates are 5 per cent for endorsed bills receivable, 5½@5¾ for first-class single names and 6 for names not so well known. The general stock market was dull and listless. In the electrical securities, however, there was a better tone, and all of the principal stocks of this class closed the week with net gains in quotations. General Electric closed at an advance of 3½ points, Metropolitan Street Railway ¼, and Brooklyn Rapid Transit ½. In outside securities there was little doing, active trading being confined to a very few issues. The total transactions for the week were as small as those for any week recently. In the electrical list no material gains are noted, while on the negative side Electric Vehicle closed with a loss of 2 points. The general tone of the market, however, is toward higher prices and increased strength. Following are the closing quotations in the four cities named:

NEW YORK.

	Oct. 6.	Oct. 13.		Oct. 6.	Oct. 13.
Gen. Elec.	137½	141	Elec. Veh.	18	15
Bklyn Rap. Tran.	52½	53	Elec. Veh, pfd.	*50	*40
Met. St. Ry.	151	151¼	Gen. Car.	5⅛	5
Am. Tel. & C.	89	—	Ill. Elec. Veh. Tran.	1	1
West. Un. Tel.	79¼	79	N. Y. Elec. Veh. Tran.	6¾	5½
Am. Dist. Tel.	25½	27½	N. E. Elec. Veh. Tr.	3	2⅞
Com. Cable	160	—	Tel., Tel. & Co. of Am.	5½	5
Elec. Boat	13	13	Hud. Riv. Tel.	116	116
Elec. Boat, pfd.	24	24	N. Y. & N. J. Tel.	160	160

BOSTON.

	Oct. 6.	Oct. 13.		Oct. 6.	Oct. 13.
New Eng. Tel.	—	—	Erie Tel.	95¼	95¼
Mex. Tel.	—	—	Gen. Elec., pfd.	139	139
Westing. Elec.	46	47	Am. Tel. & Tel.	139	141
Westing. Elec., pfd.	61	—	Ed. Elec. Lt.	—	—

PHILADELPHIA.

	Oct. 6.	Oct. 13.		Oct. 6.	Oct. 13.
Elec. Stor. Bat.	60	60	Phil. Elec.	2⅝	2½
Elec. Stor. Bat., pfd.	60	62	Pa. Elec. Veh.	2½	3
Elec. Co. of Am.	9⅛	9	Pa. Elec. Veh., pfd.	*2	*1⅞
Gen. Elec. Auto	¼	¼	Am. Rys.	28¾	28⅞

CHICAGO.

	Oct. 6.	Oct. 13.		Oct. 6.	Oct. 13.
Chicago Edison	135	135	Chicago Telep. Co.	200	200
Chic. City Ry.	242	244	Union Traction	11	11
Nat'l Carbon.	16	16	Union Traction, pfd.	49½	48
Nat'l Carbon, pfd.	79	80	Northwest Elev. Com.	21	23

*Asked. ....

BROOKLYN RAPID TRANSIT.—Mr. Widener, of the Metropolitan Street Railway Company, says: "The very last thing we should buy is the Brooklyn Rapid Transit. There is no reason why we should buy it, and there are many why we should not. Should we purchase, directly or indirectly, the Brooklyn Rapid Transit, the demand would be instantly made that we extend the 5-cent fare area over Brooklyn, and that we give for 5 cents a New York City ride, a Brooklyn city ride and a bridge ride, and this we could not do. It would be an operating impossibility, if operating is to mean getting your money back. We had better put any surplus money into Cleveland, Milwaukee, or other Western cities, where there is a chance for development with fair return."

CHICAGO ELEVATED ROADS.—The Chicago elevated roads are showing a steady gain in earnings. For September the South Side Elevated road carried 1,951,860 passengers, compared with 1,787,539 passengers in September, 1899. This is a gain of 9 per cent. For the first nine months of the company's fiscal year its gross earnings amounted to $920,517, compared with $799,370 for the same period last year. The Metropolitan Elevated carried 2,460,000 passengers in September, compared with 2,285,520 passengers in September, 1899, a gain of 7.6 per cent. For the first seven months of its fiscal year (beginning March 1) the company earned, gross, $898,171, a gain of $108,418 over last year, or 13.7 per cent.

BELL TELEPHONE.—American Telephone & Telegraph Company stock has been very strong of late upon good buying. People in position to know the facts concerning the assets and earnings of this company say, according to the *Boston News Bureau*, that it should sell above Pullman Palace Car instead of under it. They say it has more assets to show for its capital and is earning more money upon its stock, and that in time it should pay more dividends per share than Pullman and sell higher. The Pullman Company has distributed its surplus assets to its shareholders; the Bell Telephone Company has enormous reserves in its sub-companies which it has never drawn upon for its own dividends or treasury.

OTIS ELEVATOR.—A feature of the market has been the recent strength in the securities of the Otis Elevator Company. The preferred is quoted around 86 and the common, on which no dividends have yet been paid, is quoted at 26. The company in its first year calculated upon a business of $4,000,000, whereas the actual returns showed sales of more than $5,000,000. This year's operations have shown a further satisfactory increase, the sales for the first six months of the year being over $3,000,000. The company is capitalized at $11,000,000, of which $4,500,000 is 6 per cent non-cumulative preferred stock. The effect of the new competition now coming into play is likely to be seen during the current year.

RICHMOND MORTGAGE.—A million-dollar debenture mortgage, given by the Richmond (Va.) Passenger & Power Company to the Atlantic Trust Company, of New York, has been filed in Richmond. The company proposes to take up $400,000 outstanding bonds on the plant of the Richmond & Manchester Company, and to rehabilitate the entire system of the Richmond Passenger & Power Company.

WESTERN UNION.—At a special meeting of Western Union stockholders last week the issue of $20,000,000 4½ per cent funding and real estate mortgage 50-year gold bonds was duly authorized. Of these bonds $10,000,000 were duly issued and the 6 per cent and 7 per cent bonds, due March 1 and May 1, 1900, were discharged and cancelled on the dates of their maturity.

STREET RAILWAY CONSOLIDATION.—The Massachusetts Railroad Commissioners have authorized the Globe Street Railway Company, of Fall River to consolidate with the Taunton Street Railway Company, and have also authorized the Globe Street Railway Company to issue $525,000 additional stock.

BROOKLYN EDISON BONDS.—The New York Stock Exchange has listed $2,275,000 additional consolidated first mortgage 4 per cent gold coupon bonds of 1939 of the Edison Electric Illuminating Company, of Brooklyn. The total amount listed to date aggregates $4,275,000.

BOSTON EDISON.—President Edgar's annual report of the Edison Electric Illuminating Company, of Boston, for the year ended June 30, 1900, is issued, as follows:

	1899-1900.	1898-1899.
Gross earnings	$1,131,758	$1,002,261
Operating expenses	725,537	664,017
Net	406,221	338,243

Lamps and motors connected as of date June 30:

	1900.	1899.	1898.	1897.	1896.
Incandescent lamps	211,471	183,165	161,466	138,682	114,354
Arc lamps	2,131	1,791	1,486	1,446	1,112
Motors, horse-power	9,428	7,504	6,473	5,675	5,131

Balance sheet:

Assets—	June 30, 1900.	June 30, '99.	June 30, '98.
Installation	$4,499,531	$3,849,549	$3,684,249
Liverpool wh'f estate	225,912	225,912	225,812
Cash on hand	141,997	75,485	106,846
Stock on hand	43,844	66,140	65,024
Notes and accounts received	114,705	103,297	92,991
Open accounts	.....	1,645	.....
Total	$5,025,991	$4,322,030	$4,175,024

Liabilities—	June 30, 1900.	June 30, '99.	June 30, '98.
Capital stock	$3,920,000	$3,744,000	$3,744,000
Trust mortgage bonds	180,000	180,000	180,000
Notes and accounts payable	129,531	3,044	30,799
Dividends payable	78,400	74,880	74,880
Installment on new stock	161,735	24,120	.....
Reserve for maintenance	432,000	270,000	120,000
Sundry open accounts	20,903	.....	.....
Premium on new stock	40,660	.....	.....
Profit and loss	62,761	25,986	25,343
Total	$5,025,991	$4,322,030	$4,175,024

The directors have declared a regular quarterly dividend of 2 per cent, and an extra one of 1 per cent, payable Nov. 1. The stockholders have elected C. W. Amory and Robert Bacon to the board of directors, succeeding C. H. Coster and Jacob C. Rogers, both deceased.

Commercial Intelligence.

THE WEEK IN TRADE.—Last week brought little change in the general trade situation; what little there was, however, was for the better. Business everywhere seems to be waiting for the settlement of the election uncertainties, and until then no activity is looked for. The most important development of the week in the iron and steel trades was the order placed on Friday by the Pennsylvania Railroad for 150,000 tons of rails at $26 per ton. The delay in the settlement of the coal strike has naturally had a depressing influence in the districts affected. According to the *Financial Chronicle*, the railroad gross earnings for September show an increase of only 2½ per cent. The *Chronicle* suggests, however, that this may be entirely wiped out by fuller returns. The aggregate returns for the month are reported as $60,761,200, a gain of $1,316,470, being for 107 roads, operating 101,068 miles this year, against 97,678 miles in September, 1899. Copper quotations are 16⅞@17c. for Lake Superior ingots, in car loads; 16⅝@16¾c. for electrolytic, and 16½@16⅝c. for casting. The market was very quiet and very little business was transacted. *Bradstreet's* reports the number of failures for the week as 210, against 177 last week, and 164 the corresponding week last year. R. G. Dun & Company compute the liabilities of the concerns failing for the first week of October at $1,618,771, against $1,687,068 the corresponding week last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Oct. 1: Antwerp—8 cases electric material, $761. Argentine Republic—218 packages electric material, $8,747; 50 cases electric machinery, $3,195. Brazil—67 packages electric material, $2,818; 5 cases electric machinery, $438. Bristol—1 package electric material, $8; 32 packages electric machinery, $2,600. Barcelona—14 cases electric material, $840. Brussels—15 cases electric material, $327. British West Indies—30 cases electric material, $943. British Possessions in Africa—43 cases electric material, $3,424. Bremen—5 packages electric material, $218. British East Indies—1 case motors, $33; 26 cases electric material, $430. British Guiana—2 cases electric material, $73. Cuba—38 packages electric material, $1,588. Catania—34 packages electric machinery, $6,388. Danish West Indies—1 package electric material, $10. Dublin—1 package electric material, $185. French West Indies—1 package cables, $14. Glasgow—381 packages motors, $4,582; 14 cases electrical material, $1,094; 75 packages electric machinery, $15,255. Genoa—2 cases automobiles, $1,000; 174 packages electric material, $7,332. Huddersfield—13 packages electric material, $304. Havre—67 packages electric material, $3,774; 5 packages electric machinery, $157. Hayti—1 package electric material, $50. Hamburg—10 packages electric machinery, $2,154; 114 cases electric material, $7,265; 2 packages trolley material, $250. Japan—195 packages electric material, $19,723; 73 cases electric machinery, $9,384; Liverpool—66 packages electric machinery, $10,000; 43 packages electric material, $1,744; 1 case automobiles, $1,300. London—134 cases electric machinery, $5,514; 72 trolley poles, $2,375; 25 packages motors, $481; 160 packages electric material, $10,306. Marseilles—2 cases electric machinery, $180. Milan—47 packages electric material, $15,065. Mexico—18 cases electric material, $3,806. Manchester—2 cases motors, $770. Naples—99 cases electric material, $6,865. Newcastle—26 packages motor machinery, $4,000. Porto Rico—1 case motors, $25; 27 packages electric material, $446. Plymouth—1 case electric material, $6. Peru—18 packages electric material, $537. Rotterdam—28 packages electric material, $228. Southampton—1 case electric machinery, $11; 3 cases electric material, $204. Stockholm—1 package electric machinery, $80. San Domingo—2 cases electric material, $10. U. S. Colombia—22 cases electric material, $562. Venezuela—2 packages electric material, $38. Westeras—1 package electric material, $53. Zürich—1 case electrical machinery, $49.

EXPORT ACTIVITY.—The activity of American manufacturers is illustrated by the statistics of the imports of manufacturers' materials and exports of manufactured goods which have just been made public by the Treasury Bureau of Statistics. In the eight months ended with August, 1900, imports of raw materials for use in manufacturing amounted in round numbers to 200 million dollars, against a little over 100 millions in the corresponding months of 1896, and the exports of manufactured goods were 304 million dollars, against 163 millions in the corresponding months of 1896. Thus in both importation of raw materials for use in manufacturing and in exportation of the finished product, the figures of the present year are nearly double those of 1896. The total imports of the eight months just ended exceed by 93 million dollars the imports of the corresponding months of 1896, while the single item of manufacturers' materials itself shows an increase of 87 millions. Raw materials for use in manufacturing formed in the eight months of 1896 but 22½ per cent of the total imports, while in the corresponding eight months of 1900 they formed 35.2 per cent. Manufactures formed in the eights months of 1896 28.7 per cent of the total exports, and in eight months of 1900 formed 33.3 per cent, and in August, 1900, 35.2 of the total exports of domestic products. In 1896 the average importation of manufacturers' materials was 13½ million dollars per month, and in 1900 it is 25 million dollars per month.

TELEPHONE MANUFACTURE.—The entire machinery and plant of the Schmidt & Bruckner Electric Company was disposed of on Oct. 12 and purchased by the Lambert-Schmidt Telephone Manufacturing Company, which has its offices and salesrooms at 325 Broadway, New York City. This concern has also bought all the machinery and tools for all types of switchboard manufacturing from the Schmidt-Fowler Electric Company. These various changes make the Lambert-Schmidt Telephone Manufacturing Company, whose works are at Weehawken, N. J., one of the largest concerns of its kind in the country, with a modern equipment for its class of work. The experience that Mr. Schmidt has had through his connections noted above will enable him to justify his intention to turn out the highest grade of telephone apparatus.

THE MASSACHUSETTS TELEPHONE & TELEGRAPH COMPANY will probably become an operating company by Dec. 1. The company now has 175,000 feet of duct laid in the streets of Boston, and a contract will be let for 40,000 additional feet, making a total of 215,000 feet, or 43 miles of duct, which will be available for use by Nov. 1. The number of ducts in the conduits vary from 4 to 72, the larger number being on Franklin Street approaching the central station. Connections are now being made from the conduits to buildings. The company has from 5000 to 6000 subscribers under contract. The switchboard to be used in the central station has arrived from Chicago and is being installed.

WESTERN POWER PLANTS.—The Boston & Montana Company, Butte, Mont., is considering the advisability of using the water of Rainbow Falls for power for the big smelter at Great Falls. The necessity of an extra supply of water for power purposes was demonstrated during the recent dry spell. R. A. Herrick, a Boston engineer, has made estimates and will submit plans to the directors of the company for a canal large enough to use all the power of Rainbow Falls, about 75,000 horse-power. It is reported that the Boston & Montana Company is figuring on enlarging the electrolytic plant so as to give a capacity of 8,000,000 to 10,000,000 pounds of copper each month.

THE WOODS MOTOR VEHICLE COMPANY, of Chicago, has lately been making a number of important changes, and others, it is rumored, are soon to come. Mr. J. Wesley Allison is now the president, and Mr. G. H. Atkin is secretary and treasurer, while, as is well known, such men as Messrs. Seward Webb, August Belmont, John W. Mackay, Frederic Nicholls and others are prominent in the company. It is about introducing a number of new types of vehicles, from which much is expected. Mr. Allison, it is needless to add, is well known in the East as a New York Central official and from his connection with car lighting.

ARGENTINA.—The River Plate Electric Light & Traction Company, Rosario, Argentina, has been ordered by the Arbitration Court to rebuild its overhead wires, poles, etc., within six months; also to substitute for the present arc lamps others of more modern construction. These changes will necessitate the purchase of electrical material. The River Plate Company at present supplies 300 street arc lamps. Mr. Frank R. Cassels has been given the contract by the La Plata city council to build an electric supply works in that city. He will also build an electric railway to the Matadero.

AMERICAN BICYCLE COMPANY.—As anticipated in this column last week, the American Bicycle Company, in view of the decline in the demand for wheels, will turn its attention seriously to automobiles. The annual report, issued last week, says: "The manufacturing and sale of automobiles have had much attention by the executive of the company, and, as our facilities are unequaled for the manufacture and sale of such goods, we believe that the company is in a most excellent position to prosecute this branch of the business.

SPRAGUE ELECTRIC.—At a meeting of the board of directors of the Sprague Electric Company, held recently, the following officers were elected for the ensuing year: John Markle, president; Edward C. Platt, first-vice-president; Allan C. Bakewell, second vice-president; Charles P. Geddes, secretary; H. R. Swartz, treasurer and assistant secretary.

MOTORS FOR CARRIAGE WORKS.—Bender Bros., of Hamilton, O., are reported to be preparing plans for the new plant of the Jewell Carriage Company, of that city. It is understood that it will be motor driven, and that the motors, generators, engines, boilers, etc., will soon be needed.

TO PURCHASE STEAM EQUIPMENT.—Mr. H. C. Patterson, superintendent of the Austin (Tex.) water and light plant, will shortly be in the East to purchase engines and boilers, with a view to building a large steam plant to take the place of the water power plant whose dam was swept away by a great flood.

THE WESTINGHOUSE COMPANY is furnishing the Brooklyn Edison Company with two 5000-hp units, comprising 6600-volt generators and vertical compound condensing engines. Both of these units will be in service at the Bay Ridge station the early part of next spring.

General News.

THE TELEPHONE.

ST. ANNE, ILL.—A local telephone exchange will be organized at St. Anne. Herman Roy is the promoter.

CIRCLEVILLE, PA.—The Federal Telephone Company is extending its line from Circleville to Irwin, Pa.

SEDALIA, MO.—The Mutual Telephone Company is arranging to commence work on the building of its lines.

LINDSEY, OHIO.—The Central Union Telephone Company has been granted a franchise to install an exchange.

FLUSHING, OHIO.—The Flushing Telephone Company has increased its capital stock from $3,000 to $10,000.

INDIANAPOLIS, IND.—The South Whitney Telephone Company has been incorporated, with a capital of $3,000.

WALTHAM, MASS.—The Waltham central fire alarm station was destroyed by fire on Oct. 5, with a loss of $40,000.

MILWAUKEE, WIS.—The Farmers' Telephone Construction Company has been organized. Many Milwaukee men are interested.

MANSFIELD, OHIO.—The City Council has declined to grant the application for a franchise made by the Star Telephone Company.

MILWAUKEE, WIS.—The Wisconsin Telephone Company reports a net gain of 284 subscribers in September, making a total number of 19,782 subscribers.

ALLIANCE, OHIO.—The Columbiana County Telephone Company is building two long distance lines from this city to East Liverpool, via Sebring and Lisbon.

BEAUMONT, TEX.—The Texas Public Messenger Company, with headquarters in Houston, is arranging to put in a service in Beaumont. James McCane is president.

CEDAR RAPIDS, IA.—The Buchanan County Telephone & Telegraph Company, of Independence, has filed articles of incorporation, and will lay its wires underground.

PENDLETON, S. C.—The Pendleton Telephone Company has been commissioned, with a capital of $600. H. P. Litton, of Pendleton, and others are the incorporators.

BOSTON, MASS.—The Erie telephone system made a net gain of 3022 subscribers in September. Total number connected Sept. 30, 134,570; number waiting connection, 3672.

GREENSBURG, IND.—The Greensburg Telephone Company has been incorporated. Capital, $30,000. Incorporators: W. B. Hamilton, D. A. Myers, A. P. Bows, all of Greensburg.

HAMILTON, OHIO.—The City & Suburban Telephone Association, of Cincinnati, which owns the local exchange is about to increase its capital stock from $2,500,000 to $4,000,000.

NEW YORK, N. Y.—The Manhattan Railway Company will equip all its stations along the four elevated lines with telephones, which are to supplant in part the telegraph for official business.

HARRISBURG, PA.—The Wayne & Pike Independent Telephone Company has been incorporated to build a line in Pike, Wayne, Monroe, Lackawanna and Luzerne counties. Capital, $6,000.

SEATTLE, WASH.—The Sunset Telephone Company is building a telephone line from Seattle to Ellensburg, Wash., a distance of 160 miles. The line follows the Northern Pacific Railroad.

CHAGRIN FALLS, OHIO.—The Central Union Telephone Company has been refused a franchise to install an exchange at this place, with connections to its Alliance-Ravenna-Painesville lines.

PACIFIC STATES.—The Pacific States Bell Telephone Company made a net gain of 1834 subscribers in September; the total number connected is 80,686, which includes 20,162 in San Francisco.

YORK, PA.—The Cumberland Valley Telephone Company has decided to build its line from Greencastle to State line, where it will connect with the Hagerstown Company for through business.

HORNELLSVILLE, N. Y.—The Hornellsville Telephone Company has been incorporated. Capital, $50,000. Directors: Burt G. Hubbell, Cleveland, Ohio; F. D. Sherwood and James B. Day, Hornellsville.

HONEY GROVE, TEX.—The Honey Grove & Ragsdale Telephone Company, Honey Grove, has been incorporated. Capital, $1,200. Incorporators: J. W. Underwood, P. M. Price, T. U. Cole, all of Honey Grove.

MARSEILLES, ILL.—The local telephone exchange, which has been owned and operated by Marseilles citizens for a number of years, has been sold to the Central Union Telephone Company. The plant will be rebuilt.

WESTERVILLE, OHIO.—The business men of Westerville are now preparing to have a telephone line to connect Westerville with various points in the locality. Messrs. S. Chapman, J. W. Markley and others are interested.

MANSFIELD, OHIO.—The Farmers' Co-operative Telephone Company has decided to sell its exchange at Bellville and a portion of the lines in Mansfield to the Star Telephone Company, which has been making an effort to secure a city franchise.

SPARTA, TENN.—The Gainesboro Telephone Company has completed a metallic line between Smithville and this city. Connection is made with the Cumberland Telephone Company at Smithville, thus giving direct communication with Nashville.

RUSSELLVILLE, IND.—Articles of incorporation have been filed with the Secretary of State and a charter granted to the Star Line Telephone Company of this city. Capital stock, $20,000. Stockholders are: C. H. Ramsey, Leonard Wilson and W. C. Boyd.

MT. VERNON, ILL.—An injunction suit in which certain stockholders in the White County Telephone Company sought to restrain the Master in Chancery of White County from selling the plant under a decree of foreclosure was heard Sept. 29. The writ was denied.

SAN FRANCISCO, CAL.—The Western Union Telegraph Company has laid 3-in. iron pipe conduits in the First, Second and Third districts, San Francisco, and has already "pulled in" a large quantity of Standard underground cable. The Fourth District alone remains to be wired.

TRENTON, N. J.—The Exchange Telegraph Company has been incorporated under New Jersey laws, with a capital of $5,000,000. This is understood to be the company with which the Chicago Board of Trade will make contracts for the transmission of its quotations to exchanges in other cities of the country.

GRANITE CITY, ILL.—The City Council has granted the Kinloch Telephone Company a franchise to operate a local exchange. The company has already secured Madison, Venice and East St. Louis, and this franchise was all that was necessary to commence work on the East Side and make connections with St. Louis.

OTTAWA, ONT.—Toronto advices state that by a new agreement between the Bell Telephone Company, of Canada and the American Telephone & Telegraph Company, of the United States, the Canadian company has been enabled to make a reduction on all rates from Canada to the United States points. The reduction is a considerable one.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company has brought suit against Hennepin County asking for an order restraining the county attorney from attempting to collect a local tax, and that the property in Minneapolis be declared exempt from a local tax; also that the county auditor be instructed to cancel the tax which has been levied.

EAST LIVERPOOL, OHIO.—The Columbiana County Telephone Company has been unable to make satisfactory terms with the owner of the bridge over the Ohio River between this place and Chester, W. Va., and the privilege has been granted by the Government to stretch wires across at Babbs Island. Tall poles will be erected and the wires will be 100 ft. above water. Toll lines and exchanges will be installed in several towns on the other side of the river.

RAVENNA, OHIO.—As the result of the boycott placed against the Central Union Telephone Company by the grocers and meat dealers who favor the new Home Telephone Company, the former company has announced that it proposes to start a large grocery establishment and make things lively for the grocers. The Home Company claims to have gained 50 subscribers, while the Central Union Company is said to have lost nearly that number during the past month. The Home rates at 75 cents for party lines, $1 for individual wires at residences and $1.50 for offices. The Central Union rates are 50 cents, $1 and $1.50.

COLUMBUS, OHIO.—The city board of education recently called for bids on a private school telephone exchange, with connection to city systems. The Central Union Telephone Company bid as follows: Telephones in 37 schools, four extensions in library building, connection with city exchange, to be operated by board, at $1,100 per year; or place telephones in five schools, with four extensions at $174 per year; or telephones in 37 schools and buildings with independent circuits and Blake equipment throughout, $1,102 per year. The Citizens' Telephone Company offered to place telephones in five schools, library building and two extensions at $224, with 20 per cent off during closed months; or to place 20 or more telephones in various buildings and board offices, with an additional 5 per cent, or at a uniform rate of $30 each; or to put in an exchange of 50 drops, to be operated by board, with telephones in 37 buildings, at $1,200 per year. The contracts have not yet been placed.

ELECTRIC LIGHT AND POWER.

PONTIAC, MICH.—Pontiac is to have another electric lighting plant.

IOLA, KAN.—The city of Iola has voted $10,000 for an electric light plant.

ST. EDWARD, NEB.—St. Edward is to have an electric light plant, to be put in operation in the near future. It will be operated by water-power.

OLNEY, ILL.—The Olney Electric Light & Power Company, of Olney, has been incorporated, with a capital of $28,000. The incorporators are H. F. Hughes, Ed S. Hughes and W. Bower.

WARREN, IND.—At an election held in this city on Oct. 8, to determine whether or not the city should have its own system of electric lighting, the measure was carried by a substantial majority.

BLOOMINGTON, ILL.—The Consumers' Heat & Electric Company, Bloomington, has been incorporated. Capital, $75,000. Incorporators: G. P. Davis, E. Thorp, G. S. Hanna, all of Bloomington.

CUMBERLAND, MD.—The Baltimore & Ohio Railroad Company is arranging to establish an electric light and power plant at Cumberland to light all the company's property, including the Queen City Hotel.

CUMBERLAND, MD.—The Cumberland Electric Light & Power Company is now making improvements at its power house, which will cost over $30,000 when completed. Two batteries of four boilers, aggregating 1500 horse-power, are being installed.

VINELAND, N. J.—The Vineland Borough Council has awarded the contract for the construction of an electric light system to the Buchanan Company, of Phialdelphia, at $20,000. Walter Turner, of Vineland, was given the contract for erecting a power house at $6,991.65.

HUTCHINSON, MINN.—The Hutchinson Lighting & Manufacturing Company has been incorporated. Capital, $50,000. Incorporators: I. B. Jorgensen, G. B. Zickrick, P. P. Pendergast, H. C. Schluter, E. Drew, H. L. Merrill, L. A. Ritter, W. E. Harrington, H. A. Ames, all of Hutchinson.

INDIANAPOLIS, IND.—The Home Heating & Lighting Company, Indianap-

olis, has been incorporated. Capital, $250,000. Incorporators: S. E. Raugh, E. Hawkins, both of Indianapolis; C. Fairbanks, of Terre Haute. Mayor Taggart has signed an ordinance granting the company a 25-year franchise to furnish citizens electric power and lights, the latter at the rate of 10 cents per kilowatt.

CHICAGO, ILL.—The corporation counsel has been instructed to draft an ordinance fixing the price of electric lighting at a reasonable rate all over the city. The object of the proposed ordinance is twofold. First, it is expected to abolish discrimination on the part of the larger companies; second, to force the 25 or 30 plants now operating without franchises to go to the Council and ask the right to continue in business.

THE GASFITTERS' UNION in Chicago some time ago took away the conduit work on the Illinois Theatre building from the Electricians' Union with the sanction of the Chicago Building Trades Council. The electricians refused to abide by this decision and were suspended from the council. Recently the National Building Trades Council issued quarterly membership working cards to the suspended electricians over the heads of the local organization.

CHICAGO, ILL.—There is at present pending in the courts a question as to the right of the city to issue bonds to the amount of $2,500,000 for the purpose of covering the cost of contract with the drainage board for the use of the water-power at Lockport, one of the first benefits of which would be a city electrical plant that would be capable of illuminating the streets of the entire city, as well as of operating the various pumping stations of the water supply system. There is a possibility that the courts may decide adversely as to the right of the city to issue such bonds, and to meet that contingency, Mayor Harrison recently took the necessary preliminary steps. After a consultation with Corporation Counsel Walker, the mayor decided to instruct the law department to go to work at once preparing a bill for presentation to the next Legislature, empowering the city of Chicago to place the proposition before the people at next spring's city election, and in case of a favorable vote to issue the necessary amount of bonds at once.

THE ELECTRIC RAILWAY.

ST. LOUIS, MO.—The directors of the St. Louis Transit Company Sept. 29, declared the regular quarterly dividend of 1¼ per cent on the preferred stock.

ERIE, PA.—The Erie Transit Company has opened its new trolley line from this city to Cambridge Springs, a distance of 28 miles.

DENVER, COLO.—The scheme to build an electric railway from River Front Park to Boulder is being revived by J. Brisben Walker.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has completed about 15 miles of track between Hebron and Columbia.

LEXINGTON, MICH.—The Detroit, Lexington & Lake Huron Electric Railway has been granted a franchise by the Township Board for a road through Lexington, to be completed by Dec. 31, 1901.

PORTSMOUTH, OHIO.—The City Council has proposed an ordinance compelling the local street railway company to repair or abandon cars that have "flat" wheels.

PELLA, IA.—The Pella & Southwestern Railway Company has been formed by P. H. Bousquet and others of Pella. The company will be capitalized at $100,000, and proposes to run a line from Pella, several miles southwest of Howell.

COLUMBUS, OHIO.—The Columbus & Grove City Electric Railway Company has secured a franchise to extend its line from Grove City to Morgan Station, where it will provide an entrance to the city for the projected Columbus, Mt. Sterling & Washington C. H. Electric Railway.

CHILLICOTHE, OHIO.—J. C. Short, promoter of the Chillicothe & Hillsboro Electric Railway, has returned from New York, where he has been successful in financing the project. The preliminary work of building the road has been started.

GUTHRIE, OKLA.—The Union Electric Railway Company has been incorporated, with $122,000 capital stock, to build an electric street railway in South MacAlester. A. H. Howe, of New York; J. F. Craig, of South MacAlester, and R. T. White, of Fort Sill, are interested.

TACOMA, WASH.—Articles of incorporation have been filed by the Acme Magnetic Traction Company. The capital stock is $100,000, and the following are named as directors: A. A. Honey, C. S. Barlow, F. S. Steere and J. H. Wilt, of Tacoma, and Albert H. Honey, of Seattle.

HARRISBURG, PA.—The Uniontown & Monongahela Valley Electric Railway Company has been incorporated. Capital, $450,000. Incorporators: H. L. Robinson, W. C. McKean, I. E. Partridge, all of Uniontown; W. W. Staub, of Pittsburg; L. B. Hamilton, of Uniontown; A. O. Lorentz, of Meyersdale.

MONTREAL, QUE.—The earnings of the Montreal Electric Street Railway for the past year show another substantial increase in income, the figures, as compared with the previous year, being for 1899 $1,646,647 and for 1900 $1,762,220, thus making the past 12 months by far the biggest year in the history of the company.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has reorganized the elevated system, making six divisions instead of three, each under the control of a superintendent. They will be known as the Fulton Street, Brighton, Fifth Avenue, Broadway, Ridgewood and Brooklyn Bridge divisions. Superintendent George N. Edwards will have general supervision.

MONTREAL, QUE.—The town of Westmount, a suburb of Montreal, will soon have a mountain electric railway. At the last meeting of the Town Council it was unanimously decided that the sum of $2,000 per annum, for a period of 10 years, be granted to the Montreal Electric Street Railway Company, on certain conditions. The offer is subject to ratification by the town.

XENIA, OHIO.—Representatives of both the Dayton, Springfield & Urbana Electric Railway Company and the Springfield & Hillsboro Traction Company have applied to the Commissioners of Green County for a franchise through the county from Jamestown to Cedarville. The Commissioners want a road to go through Xenia, but neither company will agree to this provision.

CINCINNATI, OHIO.—Congressman Tom Johnson, of Cleveland, is backing a company which is seeking a franchise for an electric railway from Cincinnati to Red Bank. Another company is after the same right of way, but thus far Mr. Johnson's company seems to have the advantage, having offered to build a double-track road and to sell 10 tickets for 25 cents, or a single fare for 3 cents.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Electric Railway has decided to extend its Berea branch 17 miles south to Medina. An effort will be made to secure a franchise granted some time ago to Joseph Roof for a line along the Wooster pike from Cleveland to Medina, passing through Strongsville and Brunswick. If this cannot be secured a private right of way will be purchased.

ROCHESTER, N. Y.—It is stated that Rochester and Buffalo will be connected by electric road by the time the Pan-American Exposition opens next spring. Plans for the road have been carefully prepared, the route has been fully surveyed, capital has been interested, the consent of the vast majority of property owners along the line has been secured, and practically all that is needed now is the approval of the State railroad commission, which, it is believed, will be obtained without opposition.

BOSTON, MASS.—The Massachusetts railroad commissioners have authorized the Brockton & Plymouth Street Railway Company to issue $150,000 capital stock for the payment and capitalization of the cost of building and equipping its street railway. The commissioners also have authorized the Pembroke Street Railway Company to issue $20,000 capital stock for payment and capitalization of the cost of its railway. This is the first step in the consolidation of the Brockton & Plymouth Street Railway Company with the Pembroke Street Railway Company and the Plymouth & Kingston Street Railway Company. The new company will operate a through line between Brockton and Plymouth, Mass.

NEW INDUSTRIAL COMPANIES.

THE MEAD ELECTRIC COMPANY, of Marion, Ind., has been incorporated, with a capital stock of $100,000.

WASHINGTON, D. C.—The Neely Electric Company has been incorporated, capital $50,000, by F. C. Behrens, L. C. Brooks, C. C. Wheeler and others, to manufacture and deal in electrical goods.

THE ACME ELECTRIC COMPANY, of Chicago, has been incorporated to manufacture electrical supplies. Capital, $5,000. Incorporators: I. M. Crane, C. B. Stafford, W. Y. Miller, all of Chicago.

THE WASHINGTON ELECTRIC SUPPLY & MANTLE COMPANY has been incorporated at Seattle, Wash. Capital, $10,000. Incorporators: J. J. Maney, A. R. Pinkney, G. H. Leghorn, all of Seattle.

THE WASHINGTON ELECTRIC LIGHT COMPANY, of Camden, N. J., has been incorporated to furnish light, heat and power. Capital, $50,000. Incorporators: W. P. Billings, E. W. Mulligan, J. Flanigan.

THE AMERICAN TELEPHONE JOURNAL COMPANY, of New York City, has been incorporated. Capital, $1,000. Directors: William H. McDonough, Evelyn M. Maher, James F. Bannan, of New York City.

THE MANHATTAN INVENTION & MACHINE COMPANY, of Harrison, N. J., has been incorporated to deal in automatic and electric machines. Capital, $50,000. Incorporators: T. F. Lindsay, L. Golden, P. McGuiggan; T. Lindsay, attorney, New York.

LEGAL.

BOARD OF TRADE QUOTATIONS.—Judge Kohlsaat, in the United States District Court, Chicago, last week, issued a temporary injunction restraining O. M. Stone and others from distributing quotations of the Chicago Board of Trade. The complainant was the Cleveland Telegraph Company, which has the right, under its contract with the board, to disseminate the quotations. Judge Kohlsaat held: "That there exists in the Board of Trade a right of property in the quotations until they are made over to the public; that there is no such dedication to public use as will serve to defeat or terminate the property right, and that it was within the power of the board to convey to the complainant the property right, and that the complainant acquired good title by its contract." Granting that the right to the quotations is a property right, the court said that it cannot be denied that the complainant was greatly damaged by the broadcast scattering of the quotations by purloiners, who, by reason of having to pay nothing for them, could obviously render the complainant's right of property valueless.

PERSONAL.

MR. W. S. KNIGHT has severed his connection with the Gas & Electric Light Company of the City of Mexico, and has gone into business at Pachuca, Mexico.

MR. P. C. BURNS, president of the American Electric Telephone Company, Chicago, was in New York last week on a business trip. He reports the outlook in the telephone field especially bright.

MR. PERCIVAL ROBERT MOSES, a well-known electrical engineer of New York, was married on Oct. 4 to Miss Mary E. Bigler, daughter of Dr. William H. Bigler, of Gwynedd, Pa. Mr. Moses's many friends in the electrical business will wish him and his bride a long life of happiness.

DR. GEORGE F. BARKER, professor of physics in the University of Pennsylvania, has resigned owing to ill-health, and has been nominated professor emeritus. . Dr. Barker was a commissioner to the Paris Electrical Exhibition of 1889 and was decorated Commander of the Legion of Honor of France for his services.

MR. WALLACE C. JOHNSON, director and general manager of the Albion Power Company, and who has been the chief engineer of the Niagara Falls Hydraulic Power & Manufacturing Company for the past 15 years, planning and

constructing the large power plant of that company at Niagara Falls, has accpeted an appointment as chief engineer of the Shawinigan Water & Power Company, of Montreal. He will retain a position with the Niagara Company in the capacity of consulting engineer. He will have offices for general work as consulting engineer both in the office of the Hydraulic Power Company, at Niagara, and in Montreal.

EDUCATIONAL.

THE UNIVERSITY OF MISSISSIPPI has, this year, started a new department in which are given courses in electrical engineering and civil engineering. The University offers special advantages to students desiring work in engineering. It is installing an extensive electric lighting and steam heating and power plant. This University is located at University, Miss.

COOPER UNION.—A circular of information of the Cooper Union new free day schools in technical science has just been issued by the managers. This school affords young men an opportunity to pursue the branches of study which lead directly to the practice and profession of engineering. The equipment of the laboratories is sufficient to provide for practical instruction for a three-years' course of study. Further information may be obtained of Mr. L. C. L. Jordan, assistant secretary, Cooper Union, New York.

THE WASHINGTON AGRICULTURAL COLLEGE AND SCHOOL OF SCIENCE at Tacoma, Wash., in its 1900 catalogue, gives much information regarding the courses and instruction. The faculty has arranged to give elementary instruction in electrical engineering during the present season. This study will be supplemented by courses in primary and secondary batteries, electrical units and measurements, dynamo electric machinery, transformers, photometry and distribution of power. The catalogue contains the usual schedule of studies and much other information about the school.

Trade Notes.

THE UNITED ELECTRIC HEATING COMPANY, Detroit, Mich., announces that its new catalogue of its electric heating devices is now ready for distribution.

OIL FILTERS.—The Westinghouse Air Brake Company has just ordered from the Burt Manufacturing Company, Akron, Ohio, a large Cross oil filter for its power house.

GOLD, NOT SILVER.—The Cleveland Machine Screw Company writes us that it was awarded a gold medal at the Paris Exposition and not a silver one, as has been reported.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that its increased sales of Gutmann wattmeters shows a tendency in Western lighting plants to do business on a meter basis.

PARIS AWARDS.—Mr. August Mietz informs us that the 6-hp Mietz & Weiss gas engine and the 4-hp direct-connected kerosene engine and electric generator exhibited at the Paris Exposition have been awarded the silver medal.

BOLTS, NUTS, WASHERS, ETC.—M. Lanz & Sons, Twenty-ninth and Carson Streets, Pittsburg, Pa., have just issued a revised price list and catalogue of bolts, nuts, washers, hinges and heavy hardware manufactured by themselves.

BUSINESS CHANGE.—Mr. Spencer C. Crane, draughtsman, 120 Liberty Street, New York, has sold his business to Mr. Bert C. Jones, who will continue at the old address. Mr. Jones will do a business of mechanical and electrical drawing, tracing, patent drawings, etc.

THE WESTERN ELECTRIC COMPANY is carrying in stock a very complete line of two and four-pin cross arms for the electric light trade. These arms are made of selected lumber, hand-painted, and are full 3¼x4¼, the regulation size. They are being sold at very attractive prices.

ELECTRIC CAPSTANS.—The Browning Engineering Company, Cleveland, Ohio, is manufacturing an electrically driven capstan. A new type of steam dock capstan is illustrated and described in a recently issued catalogue. This catalogue will be followed by a series describing the various types of machines being placed upon the market by this company.

GRAPHITE FOR AUTOMOBILES.—The Joseph Dixon Crucible Company, Jersey City, N. J., in an eight-page pamphlet, tells of the nature of graphite, and calls particular attention to its valuable properties as a lubricant for automobiles. Dixon's pure flake graphite is prepared in various ways, so as to make it suitable for the running and wearing parts of all different types of automobiles.

COAL-HANDLING MACHINERY.—An excellently illustrated catalogue has just been brought out by the C. W. Hunt Company, West New Brighton, N. Y., in which are described the Hunt noiseless conveyor and other machinery for handling coal, ashes and similar materials in power stations. Cuts show views of this apparatus, and many installations of the same in well-known power stations.

CHINESE INDIGNATION.—Wing Chang, who launders shirts up the street, was arrested the other day for cleaning his starch ladle against a pile of McRoy conduits that was in front of his place of business. When taken before the court the officer brought a charge of "hitting the pipe," at which the Mongolian flew into a frenzy for being accused of a pleasure in which he was not aware of having indulged.

ENLARGING A FACTORY PLANT.—The Manhattan Electrical Supply Company, 32 Cortlandt Street, New York, has made arrangements to add several buildings to its already large manufacturing plant in Jersey City. The company recently purchased the business of Huebel & Manger, of Brooklyn, as was announced in last issue. This will add about 100 employees to the Manhattan Company's pay roll.

ENCLOSED ARCS.—During the last six months the Western Electric Company's series enclosed alternating arc lamps have met with remarkable success. As these lamps can be operated direct on the mains without any regulator, central station men have begun to appreciate the facility with which these can be installed, and the low cost of maintenance. Among the cities using these lamps are El Paso, Tex.; Fowler, Ind.; Chico, Calif.; Durand, Wis.; Birmingham, Ala., and Chicago, Ill.

POWER AND ELECTRIC PUMPING MACHINERY.—In a 56-page catalogue just issued by the Henry R. Worthington Hydraulic Works, Brooklyn Borough, New York, illustrating and briefly describing the more distinctive types of their electric and power pumps, they include machines of various types for all uses. The half-tone illustrations, of which there are many, are of very fine execution and highly artistic. Some serviceable engineering data are given on the last few pages.

CHANGE OF NAME.—The B. & H. Electric Company has changed its name to the Naval Electric Company. The B. & H. Company was established 10 years ago to do business in naval electrical construction and engineering. The business has grown so rapidly and so specialized that it was decided that the new name would be handier and more comprehensive and appropriate than the former title. The general offices of the company are at 95 Liberty Street, New York City, Mr. F. G. Hall, Jr., being the manager.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, has lately placed upon the market its new Western Express No. 3 bridging telephones. These new instruments are handsome in appearance and are especially adapted to heavy work over long distance lines. They are equipped with a new five-bar, laminated armature generator, which is the largest and has the heaviest output of current of any telephone generator in use. It is claimed for these instruments that over good constructed lines this generator will ring as high as 35 or 40 telephones.

THE FRANKLIN MODEL SHOP.—Messrs. Parsell & Weed, 129 West Thirty-first Street, New York, proprietors of the Franklin Model Shop, in a little pamphlet, give an outline of their business, which includes electrical testing and designing; making models for colleges, for advertising and for manufacturers; making sample articles for advertising, the perfecting of inventions, etc. In another pamphlet they give the prices of sets of castings and separate parts of the Franklin gas engine. This engine was designed for the amateur and for others who require a small power.

KEARSARGE ASBESTO-METALLIC PACKINGS.—The increasing use of high steam pressures has necessitated a packing possessing not only great strength to successfully resist these pressures, but of a material that is proof against destruction by the resulting intense heat. To meet the demand for such an article the H. W. Johns Manufacturing Company, New York, has placed upon the market its "Kearsarge" Asbesto-Metallic packing, which, it claims, is suitable for use in all kinds of high pressure and high speed work. A little pamphlet just issued by the company gives information about these packings.

RAW HIDE GEARS.—The New Process Raw Hide Company, Syracuse, N. Y., informs us that its automobile pinions were awarded the diploma of the silver medal at the recent International Automobile Exposition at Vienna, Austria. This exposition was held in connection with the Munich-Vienna races. The Raw Hide Company's exhibit on this occasion was an extensive one and was made under the supervision of its Austrian agent. The company also reports that it has recently closed a contract with the United States mint at Philadelphia to furnish this institution with "all raw-hide gears and other raw-hide articles" for one year.

ELECTRIC MINE LOCOMOTIVES.—Some interesting information about mine haulage introduces the contents of an artistic catalogue on this subject just issued from the press of the General Electric Company at Schenectady. The advantages of electric mine locomotives are pointed out briefly, and the construction of the machines is described. Excellent half-tone illustrations show the different types of locomotives and their principal electrical parts, besides views of actual installations in underground work and on roads on the surface. A table at the back of the catalogue shows that there are 177 General Electric mine locomotives in use in various parts of the country.

QUICK WORK AFTER A FIRE.—The plant of the Faries Manufacturing Company, Decatur, Ill., was visited by fire on the morning of Oct. 9, but inside of two days the matter of insurance was adjusted, the work of reconstruction was being pushed vigorously and the plant was getting into shape for renewed activity. The engine and boiler were not damaged and a number of special tools and machinery were not injured, so that within ten days or two weeks from the date of the fire the company expects to fill orders again. The concern has been doing a great business and will continue to do so immediately after resuming operations, in view of orders received. It deserves great credit for being able to get into working shape so soon after the fire.

THE HORN & BRANNEN MANUFACTURING COMPANY, of Philadelphia, Pa., designer and manufacturer of gas and electric light fixtures, has recently issued one of the most elaborately illustrated catalogues ever sent out to the trade, which is known as Catalogue No. 23. The book is 12 ins. x 16 ins., bound in heavy pebble cloth, and consists of 80 pages, illustrated with cuts from 6 ins. to 9 ins. deep. The catalogue contains in all about 160 cuts, showing all styles of electric and combination fixtures. It has also issued its Catalogue No. 24, which is illustrated with the medium-price electric and combination fixtures. These catalogues will be sent to reliable supply houses, engineers and contractors upon application.

"KILFYRE."—On Monday afternoon, Oct. 1, one of the large electric cars of the Third Avenue Line, in New York, took fire in front of the Park Row Building, and the employees of the road attempted to extinguish it with water. Capt. Martin Cook, of the Monarch Fire Appliance Company, happened to be passing by, carrying with him a tube of "Kilfyre." He at once recognized the trouble, and induced the foreman of the road to allow his men to try "Kilfyre" as a means of extinguishing the fire. The foreman consented, and "Kilfyre" was handed to his own men, who used it with instant and effective success, extinguishing the fire entirely and using only a small amount of the compound. This plainly demonstrated the superiority of this compound over water for an electric fire of this kind. A quantity of water had already been used from a sprinkler, without the desired effect.

MOTOR-STARTING RHEOSTATS.—The Ward Leonard Electric Company, Bronxville, N. Y., is calling the attention of the trade to the features of its "SK" type, 50-hp, 250-volt motor-starting rheostat of recent construction. This instru-

ment has an automatic release, combined with an interlocking overload circuit breaker, which affords complete protection to the rheostat and motor against excessive current from any and all causes. The automatic release has the "hammer-blow" feature—that is, the upper lever bearing the handle and magnet keeper travels considerable distance after being released and then delivers a strong hammer blow, which, together with the spring, drives the switch arm positively to position of open circuit. This is said to be the only absolutely "fool-proof" hand-starting rheostat ever produced. A number of these starting rheostats were recently furnished to the Diehl Manufacturing Company for the new factory of the Singer Manufacturing Company, at Elizabethport, N. J.

FREE SCHOLARSHIPS.—The trustees of the American School of Correspondence, 156 Tremont Street, Boston, Mass., have decided to depart from custom in their policy of promotion. Believing that a personal exposition of the advantages of a school is often better than, or, at least, a great help to, printers' ink, they have announced their willingness to grant a limited number of free scholarships to men in various large establishments and parts of the country. We are not advised as to the exact conditions, but any one who thinks he would like to have one is invited to correspond with them, giving his occupation, and his application will receive consideration by the trustees. The school calls attention to its courses in mechanical and electrical engineering (including a complete course in mechanical drawing), the former including steam, locomotive and marine engineering. As its work is confined to these branches, they point out the probability of better work being done than would be likely where many other branches are taught.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED OCT. 9, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

659,237. MINER'S SEPARATING PAN; A. J. Ketelsen, Chicago, Ill. App. filed May 18, 1900. An attachment for a miner's separating pan, consisting of a magnetic body supported at the top of the pan and extending into the body of the same, with means for rotating it. To be used to extract iron, etc., from gold after washing.

659,244.—CIRCUIT CONTROLLER; A. Lungen, New York, N. Y. App. filed Feb. 23, 1900. Relates to circuit controllers adapted to be operated in a somewhat similar manner to ordinary push-buttons, or automatically by the movements of a door, the device being then located in the jamb of the door.

659,268. GLOWER HEATING APPARATUS FOR ELECTRIC LAMPS; J. Van Vleck and W. N. Stevens, New York, N. Y. App. filed April 27, 1900.

659,269. ANNUNCIATOR FOR TELEPHONE EXCHANGES; B. Waller, Detroit, Mich. App. filed Dec. 20, 1897. Provides a visible signaling system by which a number of drops may be actuated through a single circuit, thus reducing the number of wires needed.

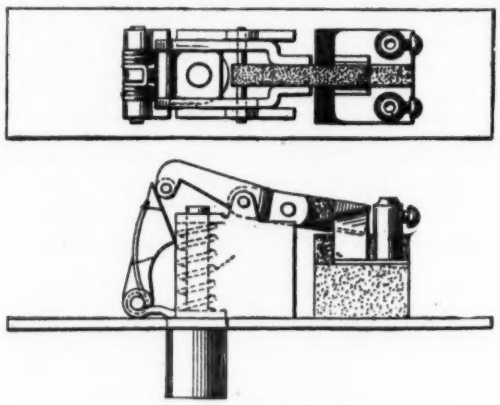
659,335. BASE FOR TROLLEY POLES; A. C. Wolfe, Freeport, Pa. App. filed Dec. 26, 1899. Structural details.

659,355. TROLLEY FINDER AND GUARD; H. C. Williams, Pasadena, Cal. App. filed April 26, 1900. The wheel is carried in a pivoted frame, which is spring-pressed against the trolley wire. There is also a pivoted finder movable with the the frame and adapted to lie below the wire when the wheel is in place and assume an upright position when the wheel is displaced.

659,357. APPARATUS FOR LOCATING FAULTS IN ELECTRIC CIRCUITS; W. E. Athearn, New York, N. Y. App. filed Jan. 23, 1899. Comprises a double-contact relay having one of its contacts connected with the faulty line and the other with a grounded battery, the lever of the relay being connected with a grounded condenser and actuated by an interrupted local circuit. An inductor in circuit with an indicator is held contiguous to the faulty circuit.

659,389. ELECTRIC METER; T. A. Edison, Llewellyn Park, N. J. App. filed Sept. 24, 1898.

659,409. ELECTRIC BIPOLAR DILATOR; C. L. Mosher, Chatham, N. Y. App. filed Aug. 25, 1900. A rectal or other dilator, the expanding blades of which are provided with contact plates or poles adapted to be included in



659,244.—Circuit Controller.

an electric circuit and constitute the terminals of a source of electrical supply.

659,417. SELF-ADJUSTING CIRCUIT BREAKER FOR ELECTRICAL WELDING MACHINES; J. C. Perry, Clinton, Mass. App. filed March 26, 1900. The "upset," that is, the displacement of the parts, or movement in the line of pressure that occurs in making the weld after the opposing faces become softened, is utilized to operate a circuit breaker, so that a predetermined amount of upset may be automatically produced.

659,443. COMMUTATOR AND METHOD OF MAKING SAME; E. R. Gill, New York, N. Y. App. filed March 1, 1900. The method of making commutators, which consists in forming an insulating cylindrical core, fitting thereon a conducting tube long enough to overhang said core, turning in the circular edge of said tube so as to make it grip the core, and cutting the tube and core into peripheral sections.

659,433. PERFORATOR FOR PREPARING TELEGRAPHIC MESSAGES; C. L. Buckingham and E. Germann, New York, N. Y. App. filed Jan. 13, 1898. Various improvements, which are embodied in a machine provided with two rows of punches, organized to perforate the material in two rows, it being particularly adapted to print groups of characters representing the Morse alphabet.

659,467. ELECTRICAL ILLUMINATED BUTTON; W. A. Church, Pittsburg, Pa. App. filed Dec. 9, 1899. A cuff button provided with a miniature electric lamp.

659,499. SIGNAL SYSTEM; I. W. Ullman, New York, N. Y. App. filed Nov. 17, 1899. The ordinary push-button and annunciator system is used as an essential part of an alarm system, the same battery being used in order to lessen expense.

659,506. MAGNETIC REGULATOR FOR GALVANOMETERS; J. J. Bradley, Newark, N. J., and L. M. Pignolet, Orange, N. J. App. filed April 13, 1899. A volt-amperemeter specially designed for the regulation and measurement of small currents, such as are used for heating the jaws of forceps or other surgical instruments.

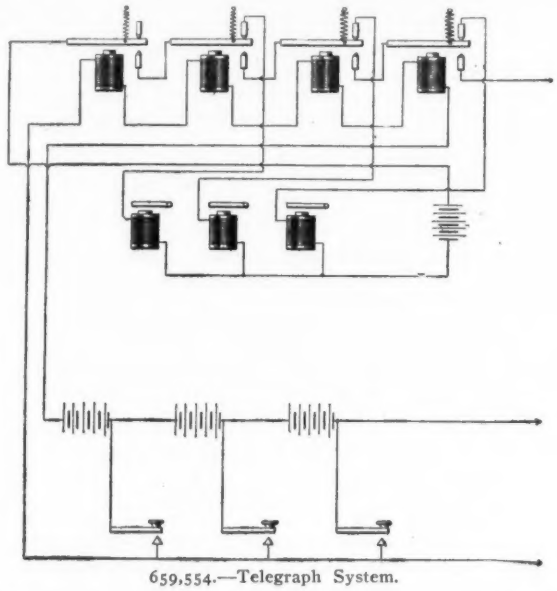
659,515. INCANDESCENT STRUCTURE SUITABLE FOR LIGHTING; J. H. H. Duncan and T. Barnett, London, England. App. filed Oct. 26, 1899. An incandescent structure suitable for lighting, comprising filaments or threads of different refractory substances arranged in proximity to each other, some of the filaments or threads being adapted to emit light of a different color to that emitted by the other filaments or threads.

659,544. TELEGRAPH SYSTEM; F. D. Pearne, Davenport, Ia. App. filed April 16, 1900. A system wherein signals may be sent from each key to its respective sounder without operating the other sounders, the signals from all keys passing over the same wire. The sounders are provided with relays operable by currents of successively greater intensities.

659,546. RECEPTACLE FOR PLUGS OR PLUG-SWITCHES; C. D. Platt, Bridgeport, Conn. App. filed June 27, 1900. Details of construction.

659,550. ELECTRIC RAILWAY; J. D. Robertson, La Salle, Ill. App. filed Jan. 31, 1900. Details which provide for arranging a current conductor so as to act as a heating medium for the distributing rails or cables.

659,559. LIGHTNING ARRESTER; C. M. Taylor, Georgetown, Ky. App.



659,554.—Telegraph System.

filed June 12, 1900. A pair of grounding plates, one connected with line conductor and other with ground, are spaced apart by a frame of insulating material which supports one of the plates. The device operates to ground the lightning current without grounding the working current.

659,588. TELEPHONE SWITCHBOARD ANNUNCIATOR AND JACK; C. T. Mason, Sumter, S. C. App. filed Nov. 28, 1899.

659,605. ELECTRIC THERMOSTAT; L. H. Des Isles, Cambridge, Mass. App. filed Jan. 10, 1900. Applied to journal bearings to give an alarm when the bearings become unduly heated. Two terminals normally separated will be connected electrically by a body of mercury whenever the temperature rises to a predetermined point.

659,631. DEVICE FOR REMOVING AND REPLACING INCANDESCENT LAMPS; R. Croteau and R. J. Messier, Denver, Colo. App. filed June 11, 1900. Comprises a number of gripping fingers carried on the end of a long pole, with mechanical devices for opening and closing the fingers over a lamp bulb. To be used for lamps located in inaccessible places.

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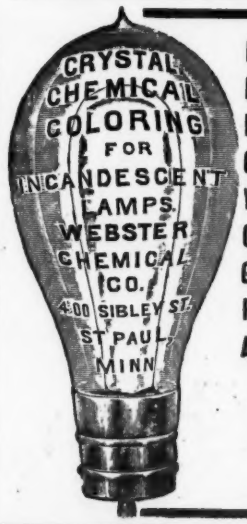

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17-19 Beale St. and 18-24 Main St., SAN FRANCISCO., CAL. (3)

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POSITION WANTED—Young man, 22, unmarried, technical education, with about 18 months' experience, desires a position with power, lighting, street railway or construction company; willing to go anywhere; very best references; correspondence solicited. Address "W. L. H.," care Electrical World and Engineer, New York.

POSITION WANTED—Electrical and mechanical engineer; technical graduate; eight years' experience; good mechanical draughtsman; have had charge of installation work for large concerns; used to handling men; familiar with power plant, testing and experimental work; used to handling and care of instruments; not afraid of hard work and moderate pay. Address "H. M. P.," care Electrical World and Engineer, New York.

POSITION WANTED—By a practical electrician and electrical engineer; graduate of Columbia University; three years' very general practical experience in designing, testing, construction and erection; at present with very big plant; wish to make a change. Address "LENOX," care Electrical World and Engineer, New York.

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BOOKS

ELECTRICAL WORLD AND ENGINEER,

ON ALL ELECTRICAL SUBJECTS.

120 Liberty St., New York.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

110-VOLT INCANDESCENT DYNAMOS.

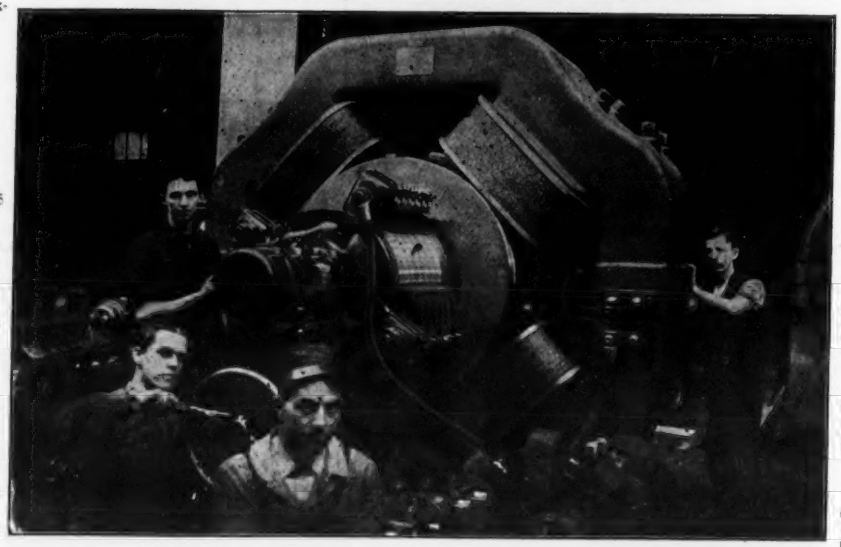
1	12-light	Hartley, self-oiler, M.P.
2	12 "	Edison, ¼ K.W.
1	26 "	Perett.
1	50 "	Hawkeye.
1	50 "	Card, self-oiler.
1	50 "	Nowotny, self-oiler.
1	50 "	C & C, self-oiler.
1	50 "	Mather.
1	60 "	T.-H., 75 volts, comp., with extra armature.
1	75 "	Thomson-Houston, D5.
1	75 "	Wood, self-oiler.
1	90 "	Westinghouse.
1	100 "	Cutten.
1	100 "	Jenney, comp.
1	200 "	Western Electric, self-oiler.
1	225 "	United States.
1	250 "	Westinghouse, horiz. type.
1	250 "	Commercial, comp., self-oiler.
1	270 "	T.-H., comp., self-oiler, D15.
3	270 "	Westinghouse, M.P., s. s., 15 K.W., October delivery.
1	300 "	Columbian, M.P., s. o.
1	340 "	Eddy, self-oiler, compound.
2	350 "	Hawkeye, comp. wound.
1	350 "	National, self-oiler, compound
3	350 "	Edison, 20 K.W., self-oilers.
1	350 "	Fisher, M.P.
1	360 "	Duplex, M.P., self-oiler, compound, slow speed.
1	450 "	Edison, 25 K.W., self-oiler.
1	540 "	Edison, 30 K.W.
4	540 "	Edison, 30 K.W., s. o.
4	540 "	Edison, 30 K.W., self-oilers compound.
1	600 "	Eickmeyer.
1	700 "	Siemens & Halske, 40 K.W multipolar, slow speed.
2	700 "	Westinghouse, 10-pole, slow speed, 40 K.W., s. o., new
4	800 "	Edison, 45 K. W., self-oilers.
1	1350 "	Waddell-Enz, 80 K.W., M.P., for direct connection.

220-VOLT GENERATORS.

1	7½ K.W.	Gen. Elec., M.P., self-oiler.
1	9 "	Lundell, self-oiler.
1	10 "	Lundell, s. o., M.P., slow sp.
1	12 "	Eddy, s. o., new arm't.
1	15 "	Edison, compound, self-oiler.
1	25 "	Edison, self-oiler.
1	30 "	Crescent, M.P., self-oiler.
1	50 "	Westinghouse, comp, s. o.

500-VOLT GENERATORS.

2	15 K.W.	Edison, self-oilers.
1	15 "	T.-H., self-oiler.
1	25 "	T.-H., s. o., D25, compound.



VIEW RECONSTRUCTING A GENERATOR, GREGORY ELECTRIC CO.

1	25 K.W.	Edison, self-oiler.
1	35 "	Mather, self-oiler.
3	45 "	Edison, compound, self-oilers.
1	75 "	Westinghouse, Kodak set, direct-connected.
1	75 "	Westinghouse, M.P.
1	150 "	Detroit (Rae), M.P., compound, s. o., new armature.

ALTERNATING GENERATORS.

1	350-light	T.-H., A18, 15,000 alt., 1100 v., comp. wound, with exciter.
1	600-light	Bain, 30 K.W., s. o., 1100 or 2200 v., new toothed arm't, 15,000 alt., with exciter.
2	600 "	T.-H., A6, 30 K.W., 15,000 alt., 1100 volts, s. o., with exciter.
1	600 "	T.-H., 30 K.W., 2-phase, 1100 volts.
1	600 "	Gen. Elec., A30, slotted arm't, compound, s. o., 1100 volts.
2	650 "	T.-H., A35, s. o., 15,000 alt., 1100 v., composite wound.
2	750-light	Westinghouse, 16,000 alt., s. o., 37½ K.W.
1	1000 "	Wood, 50 K.W., s. o., 16,800 alt., 1100 v., toothed arm't, comp. wound.
1	1200 "	Westinghouse, 60 K.W., s. o., toothed arm't, 1100 volts.
2	1200 "	G. E., A60, 1100 or 2200 volts, 15,000 alt., comp. wound, toothed arm't, self-oiler.
1	1300 "	T.-H., A70, 1100 v., 15,000 alt., s. o., compound wound.
1	1500 "	Wood, 75 K.W., 1100 volts, 16,800 alt., self-oiler, comp. wound, slotted armature.
1	2000 "	T.-H., 100 K.W., 1100 volts, 15,000 alt., self-oiler, toothed armature.
1	2000 "	Wood, 100 K.W., 1100 v., 16,800 alt., s. o., toothed arm't, comp. wound.
1	4000 "	Wood, 200 K.W., 1100 v., 16,800 alt., s. o., slotted arm't, comp. wound.

ARC DYNAMOS.

1	20-light	2000 C.P.	Western Electric.
1	30 "	2000 "	West. Electric, s. o.
1	30 "	2000 "	Brush, No. 7, with latest improved Steubenrausch commutator.
2	35 "	2000 "	T.-H., LD2.
1	40 "	2000 "	West. Electric, s. o.
1	45 "	1200 "	T.-H., M12, ball arm.
1	45 "	1200 "	Brush, No. 7, with latest improved Steubenrausch commutator.
1	50 "	1200 "	T.-H., LD12, ball armature.
1	50 "	2000 "	T.-H., MD2, s. o., ring armature.
1	50 "	2000 "	Brush, No. 7½.
2	60 "	2000 "	West. Electric, s. o.
1	60 "	2000 "	Westinghouse, toothed arm't, 6-pole, direct current, s. o., complete with exciter.
2	60 "	2000 "	Wood, No. 8.
1	65 "	2000 "	Brush, No. 8, new arm't, extra fine, with latest improved Steubenrausch fireproof commutators.

LOOK OVER OUR STOCK

SPECIAL LIGHTING MACHINES. IMMEDIATE DELIVERY

We carry all modern types—*General Electric, Westinghouse* and other standard makes. The following "*a* few of 'em." *Send for new catalog—just out.*

ALTERNATORS.

1 300-kw Fort Wayne, 2000 volts, 7200 alternations, single phase.
40-kw Stanley, two-phase, 380 r. p. m., with engines direct-connected.
2 300-kw Westinghouse, single phase, toothed armatures.
1 220-235-kw Westinghouse, single phase, 1100 volts, 450 r. p. m., 7200 alternations.
1 150-kw Westinghouse, two-phase, 1100 volts, 600 r. p. m., 7200 alternations.
2 A-120 General Electric, single phase, 1000 volts, 16,000 alternations.
2 90-kw Gen. Elec., single phase, 1000 volts, 16,000 alternations.
2 120 Westinghouse, single phase, 1100 volts, 16,000 alternations.
2 100-kw monocyclic General Electric, 1050 volts, 7200 alternations, with exciters.
1 60-kw General Electric, single phase, 2000 volts, 16,000 alternations.
1 75-kw Stanley, 2000-1000 v., two-phase, 16,000 alternations.
1 200-hp Westinghouse motor, two-phase, 3000 alternations, 400 volts, shaft 4⅞-inch diameter, pulley 25-inch face, 30-inch diameter.
1 45-kw Westinghouse, 2200 volts, 16,000 alternations.
1 110-kw Fort Wayne, 2200 volts, 16,000 alternations.

RAILWAY GENERATORS.

1 500-kw M.P., 4, Gen Electric.
1 300-kw M.P., 4, Gen. Electric.
1 200-kw M.P., 4, Walker.
1 111-kw M.P., Westinghouse.

RAILWAY MOTORS.

G. E. 800, S. R. G., 30.
G. E. 1000, W.P., 30.
G. E. 1200, W.P., 50.
Westinghouse 3.
Westinghouse 12A.
Westinghouse 38B.
K, K2 and K12 G. E. Controllers.
Westinghouse 38 and 49 Controllers, and a constantly changing stock of everything pertaining to street car equipment.

DIRECT-CURRENT DYNAMOS.

110 VOLTS.
(Direct-Connected.)

2 100-kw Westinghouse, 8-pole, 225 r. p. m., direct-connected to McIntosh & Seymour compound engines.
1 75-kw Siemens & Halske, direct-connected to 12x14 inch straight line engine, 278 r. p. m.

BELTED DYNAMOS.
110 VOLTS.

2 150-kw Edison Bipolar.
4 60-kw " "
2 45-kw Edison Bipolar.
3 30-kw " "
4 25-kw " "
2 20-kw " "
2 15-kw " "
2 10-kw " "
1 100-kw M.P., 6, Westinghouse.
2 60-hp M.P., 6, Westinghouse.
1 500-ampere Onondaga.
1 25-kw Electro Dynamic.
1 30-kw Western Electric, M.P., 500 r. p. m.
1 45-kw General Electric, M.P., 850 r. p. m.

DIRECT-CURRENT MOTORS AND GENERATORS.

220 VOLTS.
(Direct-Connected.)

1 75-kw General Electric, direct-connected to Ideal engine.

(Belt-Driven.)

1 70-kw, M.P. Siemens-Halske (new).
1 65-kw Siemens-Halske.
1 25-hp Sprague, bipolar.
1 15-hp Perrett, M.P.
1 12-hp Excelsior, M.P.
1 10-hp Eddy, bipolar.
1 5-hp Eddy, bipolar.

DIRECT-CURRENT.
500 VOLTS.

2 60-kw Edison.
2 50-hp, M.P., General Electric, type H.
1 10-hp Eddy.
1 2-hp Cent. Elect. Co.

ARC DYNAMOS.

2 125-light multi-circuit Brush, 2000-cp.
2 165-light, multi-circuit Brush, 1200 cp.
2 125-light, latest type Fort Wayne, 2000 cp.
2 125-light, brand new Excelsior, 2000 cp, $1,500 each.
2 125-light, multi-circuit Brush, 2000 cp.
2 80-light, single circuit Brush, 2000 cp.
4 No. 8, 65-light, 2000 cp, Brush, $575 each.

ENGINES.

26 x 48 Allis.
16 x 25 x 15 Armington & Sims.
18½ x 18 McIntosh & Seymour.
16 x 16 Erie Ball.
13 x 14 McIntosh & Seymour.
14 x 13 Armington & Sims.
11 x 19 x 24 Tandem Buckeye.

BOILERS.

2 375-hp Sterling boilers.
2 175 hp Sterling boilers.

Boilers of various styles and sizes at low rates.

STREET CARS.

Open and closed, of all sizes, and for all gauges. *Let us know your wants.*

We Make a Specialty of Street Railway and Lighting Machinery

ROSSITER, MAC GOVERN & CO.

Principal Offices, **141 BROADWAY, N. Y.** ***Factory,*** **BROOKLYN, N. Y.**

2 75-light 1200 C.P. Wood.
2 75 " 1200 " Standard.
2 75 " 1200 " Standard, s. o., air-insulated commutator, complete with regulator.
2 75 " 2000 " Westinghouse, s. o., toothed arm't, direct current, 6 poles, complete with exciter.
3 125 " 1200 " Excelsior, latest type, s. o., fine.

110-VOLT MOTORS.

1 ¼ H.P. Elbridge.
2 ½ " Roth.
2 1 " Belding, M., multipolar.
1 1 " Roth, s. o., new arm't.
2 1 " Edison, ¾ K.W., s. o.
1 1 " Hartley, M.P., s. o.
1 2 " Perret, self-oiler.
1 3 " Hawkeye.
1 3 " Westinghouse.
1 3 " Jenney, self-oiler.
1 3 " Nowotny, self-oiler.
1 3 " Mather.
1 3 " Card, s. o., Manchester type.
1 3 " C & C, self-oiler.
1 5 " Wood, self-oiler.
1 6 " Thomson-Houston.
1 7½ " Cutten.
1 7½ " Jenney.
1 7½ " Westinghouse, hori. type.
1 18 " Westinghouse, horiz. type.
1 18 " United States.
1 18 " Commercial, self-oiler.
1 18 " T.-H., self-oiler, D15.
1 20 " H. P. Columbian, M.P., self-oiler, slow speed.
3 20 " Westinghouse, M.P., slow speed (October delivery).
1 24 " Eddy, self-oiler.
2 25 " Hawkeye.
1 25 " Edison, 20 K.W.
4 25 " Edison, 20 K.W., self-oilers.
1 25 " Duplex, M.P., s. o., s. s.
1 25 " National, self-oiler.
1 30 " Edison, 25 K.W., s. o.
1 35 " Edison, 30 K.W.
5 35 " Edison, self-oilers, 30 K.W.
1 40 " Eickmeyer.
1 50 " Siemens & Halske, M.P., self-oiler, slow speed.
2 50 " Westinghouse, 10-pole, slow speed, 50 K.W., s. o., new.
4 60 " Edison, 45 K. W., self-oilers.

220-VOLT MOTORS.

1 1 H.P. Edison, self-oiler.
2 1 " E. & C., new, s. o., M.P., s. s.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

BARGAINS FOR SALE.

1 3 H.P. Crocker-Wheeler, s. o., s. s.
1 3 " G. E., type I. B., self-oiler.
1 3 " C & C, self-oiler.
1 5 " Eddy, ring type, self-oiler.
1 5 " Westinghouse, self-oiler.
1 7½ " Roth, self-oiler.
1 7½ " Edison, self-oiler.
1 8 " G. E., multipolar, self-oiler.
1 10 " Eickmeyer, elevator motor, with controller.
1 10 " Lundell, self-oiler.
1 12 " Lundell, 10 K.W., M. P., self-oiler, slow speed.
1 15 " Eddy, self-oiler, new arm't.
1 18 " Edison, self-oiler.
1 30 " Edison, 25 K.W., self-oiler.
1 40 H.P. Crescent, M.P., slow speed.
1 50 " Northern, M.P., self-oiler.
1 60 " Westinghouse.
1 75 " Sprague, s. o., new arm't.

500-VOLT MOTORS.

1 1 H.P. Crocker-Wheeler, s. o., s. s.
1 1 " Lundell, s. o., s. s.
1 3 " Hobart, self-oiler.
1 3 " Jenney, self-oiler.
2 3½ " Rockford, iron clad, s. o.
1 10 " Eddy, self-oiler, M.P.
1 10 " C & C, self-oiler.
1 10 " Commercial, self-oiler.
1 10 " Card, M.P., s. o., s. s.
1 15 " Eddy, self-oiler.

100,000 Lights capacity in Transformers fully tested and guaranteed in stock ready for immediate shipment. Large stock of Watt meters, ampere hour meters, station instruments, arc lamps and supplies.

☞ Send for our *Monthly Bargain Sheet* with complete list in stock and lowest net cash prices.

All apparatus is fully guaranteed to be in perfecf operating condition.

1 18 H.P. T.-H., self-oiler.
2 18 " Edison, 15 K.W., self-oilers.
2 18 " C & C, self-oilers.
1 20 " Commercial, self-oiler.
1 20 " Card, self-oiler.
1 30 " T.-H., self-oiler, D25.
1 30 " Edison, 25 K.W., s. o.
1 40 " Mather, self-oiler.
1 60 " Edison, 45 K.W., self-oiler.

ALTERNATING CURRENT MOTORS.

1 ¼ H.P. Stanley, 100 volts, 16,000 alt., single phase.
2 1 " Ft. Wayne, 100 v., 125 cycle, self-oiler, single phase.
1 2½ " Ft. Wayne, 100 volts, self-oiler, single phase.
1 5 " Wagner, single phase, 60 cycle, 200 volts.
1 1 H.P. Westinghouse, s. o., 2-phase, 60-cycle, 100 volts.
1 10 " G. E., s. o., 3-phase, type 8-10-900, Form A, 60-cycle, 110 v.

AUTOMOBILES.

1 Wood's electric runabout, with top, carries 2 persons, practically new.
1 Electric open phaeton, seats 3 persons, fine condition.
1 Electric "trap," carries 4 persons, new.

RAILWAY MOTORS.

2 F6, 220 volts, for railway or crane work.
1 Factory truck, 4 ft. 8 ins. gauge, equipped with two F6 T.-H. 220-volt motors, complete.

ELECTRIC HOIST.

1 20 x 21 in. drum, geared 28 to 1, equipped with 5 H.P. Detroit, 500-volt series motor, complete.

MOTOR-GENERATORS.

1 Siemens & Halske, 10 K.W., M. P., iron-clad type. Motor, 90 amp., 110 v.; generator, 275 amp., 26 v., mounted on same base.
1 Edison, 1½ K.W., 500 v. to 110 or 60 v.

PLATING DYNAMOS.

1 Eddy multipolar, 600 amp., 5 v., s. o., fine, capacity 2000 gal. nickel solution.

DYNAMOS = MONEY SAVERS! = ENGINES

We offer for the consideration of careful and experienced buyers about **100,000** lights in

TRANSFORMERS, OF STANLEY, T.-H., GENERAL ELECTRIC, WESTINGHOUSE, DIAMOND, SLATTERY

and other well-known types.

PRICES THE LOWEST

Goods of the Very Best Quality. Repaired, Tested and Painted. With New Lead Wires.

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THOMPSON SON & CO., 107 LIBERTY STREET, N.Y.

BARGAINS IN SECOND-HAND ELECTRICAL MACHINERY.

DYNAMOS—110 VOLTS.

1— 12-light Elbridge, s. o., new.
1— 100-light Daft.
1— 250-light U. S.
1— 350-light Davis.
1— 800-light G. E.
1—1800-light Fort Wayne, 6-pole.

ARC DYNAMOS.

1 Brush,	1 light,	3000-cp.
1 Brush,	3 light,	2000-cp.
2 American Wood,	20 lights,	2000-cp.
1 Western Electric,	30 lights,	2000-cp.
1 T.-H., L. D.-2,	35 lights,	2000-cp.
1 Wood No. 6,	35 lights,	1200-cp.

GENERATORS.

1 U. S., 15-kw, 110 volts.
1 Davis, 22-kw, s. o., 110 volts.
1 Ft. Wayne, 6-pole, 100-kw, 110 volts, new.
1 Edison, 12-kw, s. o., 220 volts.

		compound,
1 Wood B. P.,	45-kw, s. o.,	500 volts.
1 T.-H., M.P.—75,	75-kw, s. o.,	500 volts.
1 Edison No. 32,	100-kw, s. o.,	500 volts.

ALTERNATING GENERATORS.

1—3A Slattery, 1300 lights, 16,000 alternations, 1100 or 2200 volts, s. o., with exciter.
1—A60 G. E., 1200 lights, 15,000 alternations, 1100 or 2200 volts, s. o., with exciter.

ARC LAMPS, ARMATURES, TRANSFORMERS, INSTRUMENTS, SWITCHES.
A Large Assorted Stock.

MOTORS—110 VOLTS.

⅛-hp Diehl, s. o.
¾-hp Edison.
¾-hp Elbridge, s. o.
1-hp Sprague.
1-hp Card.
3-hp Nowotny.
10-hp Daft.
20-hp U. S.
28-hp Queen City, s. o.

MOTORS—220 VOLTS.

1-hp Nowotny.
5-hp Davis.
10-hp E. R. & C. C., s. o.
10-hp Daft, 800 r. p. m.
15-hp Edison, s. o.

MOTORS—500 VOLTS.

20-hp Davis, s. o.
25-hp Brush, 350 r. p. m.
60-hp Wood, B. P., s. o.
90-hp T.-H., M.P., s. o.
120-hp Edison, B. P., s. o.

STEWART ELECTRICAL CO., S. E. Cor. Fifth and Sycamore, CINCINNATI, O.

FOR SALE--Immediate Delivery

One 325 H-P simple automatic cut-off Engine, extra heavy for 130 lbs. pressure.
Two 125 H-P Scotch Marine Boilers, 130 lbs. pressure.
Two 40 H-P Scotch Marine Boilers, 100 lbs. pressure.
One 80 H-P Return Tubular Boiler, 100 lbs. pressure.
One 100 H-P Return Tubular Boiler, 100 lbs. pressure.
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Meadville, Pa.

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I have for sale 30 shares of Texas Arm & Pin Co. stock which I offer at par. This is one of the most flourishing institutions in the South, and my only reason for selling is bad health. Will be pleased to give any further information upon application. Shares are $100 each.

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ELECTRICAL WORLD AND ENGINEER
120 Liberty Street, New York

.... The Theory and Calculation of ....

ALTERNATING-CURRENT PHENOMENA

BY CHARLES PROTEUS STEINMETZ

This is the first work yet written in any language dealing in a complete and logical manner with all of the phenomena of alternating currents and their calculation in the design of alternating-current machinery. In the first six chapters the various primary conceptions and methods of treatment are developed, the use of complex quantities being explained in a remarkably clear and effective manner. The various alternating-current phenomena are then taken up in turn and the more complex parts of the subject approached so gradually and with such a logical preparation that but little if any difficulty will be met in their understanding. The remaining chapters of the book, forming half of its contents, are devoted to the methods of calculation of transformers, simple alternating and polyphase generators and motors, all of the various reactions involved being thoroughly analyzed and discussed. The work contains the very latest knowledge relating to alternating-current phenomena, as applied in engineering, much of which is original with the author, and here appears for the first time in book form. The eminent authority of the author and the original methods he pursues have assigned to this work a high place in electrical literature, where it takes rank as a classic.

Copies of this or any other electrical book published will be sent by mail, postage prepaid, to any address in the world, on receipt of price.

October 20, 1900.

Supplement to

Electrical World and Engineer

Kansas City Meeting of the American Street Railway Association.

BY TELEGRAPH.

(From Our Special Correspondent.)

The New York special train which left on Sunday morning with a large party, and which picked up a good Boston contingent at Albany, arrived in Kansas City on Tuesday morning all well, a longer delay than was at first intended having been made at St. Louis. There is a very large attendance at the convention, all things considered, and the standard of past years is more than maintained. The Midland Hotel is crowded with delegates and supply men, and the general reports from all quarters are indicative of prosperous conditions throughout the street railway industry.

The convention was called to order by President J. M. Roach, of Chicago, when Mayor Reed extended to the association a cordial welcome to the city. He referred to the rapid growth of the community and touched upon the effect that street railways had had upon the increase of population and the comfort and welfare of the people. President Roach then delivered an admirable address, in which he gave the street railway investment in the United States as not less than $1,800,000,000. He estimated the annual dividends at about $70,000,000, and wages at $250,000,000. The number of employees he estimated at the large total of 300,000. In the management of street railway systems he laid stress upon the maintenance of amicable relations with both the public and the employees.

In the course of his remarks Mr. Roach said: "An industry of such proportions penetrates and more or less affects all other enterprises in the country which sustains it. Nine-tenths of the business men and women of the United States look to the management of street railway companies to furnish them with swift, comfortable and safe transportation to and from business. Still a greater per cent of pleasure seekers demand and receive from the same management to and from theatre, casino, park and suburb, transportation of such elegance of equipment and efficiency in service as to satisfy the most exacting. It has required heroism and patience on the part of street railway men, with so little friction, to meet the demand of a critical patronage in so excellent a manner as is being accomplished by them at the present time.

"A business so widespread in its usefulness, holding and judiciously employing as it does so great a portion of the capital of the country, and so essential to the best interests and prosperity of the trade centres, should, and I believe in good time will, possess the very necessary good will and hearty support of the municipalities it so faithfully serves. Our interests and those of the public are inseparably interwoven and naturally harmonious. If such interests become strained, therefore, it should become one of the leading features of our association to suggest a uniform policy for street railway companies of so broad a gauge that the mutuality of the best interests of the public and of the company shall be as apparent to the people as to the street railway managers themselves."

Various routine business was taken up, including the reports of the executive committee, secretary and treasurer. Mr. D. B. Holmes, counsel of the Metropolitan Street Railway Company, of Kansas City, then read a paper upon the consolidation of street railways and its effect upon the public. This paper pointed out the economies effected by the consolidation of management, in the generation of power at large central plants and its distribution, and in the stimulation of traffic possible with one comprehensive system. One great benefit to the public from it came in the development of a liberal transfer system. There was no discussion of the paper.

In the course of his paper Mr. Holmes said: "Perhaps the most important result from consolidating street railway lines is the great stimulus it affords to street railway traffic. Outside of a few of the very large cities where the problem is not how to get business, but how to successfully handle that business which of necessity must come to the car lines, the street railway companies are quite generally engaged in efforts of all kinds to create travel on the lines artificially by offering to the public attraction of various and sundry kinds. This is all well enough, but one of the most effective means to this end is the consolidation of the street car lines. I believe it is the uniform experience that the aggregate travel on the united lines exceeds by a large percentage the business formerly done by the separate properties. This is partially accounted for by the fact that short distances are now ridden which were formerly walked because two fares were then necessary in order to ride, and this was considered too great an outlay for the accommodation afforded. But how stands the case with the public? I am altogether sure it is no different. Indeed, the immediate benefit to those who ride upon the cars far exceeds the increased returns to the consolidated company. Where before the union, two, and even three fares in some instances had to be paid in order to convey the passenger to his destination, he may now take the same journey for a single fare by means of transfers and through cars which were previously impossible. Taking Kansas City as an example: Fifty per cent of all the passengers who ride on the cars make at least one transfer in every journey, so that it may be truly said that 60,000 passengers save 5 cents each and every day in the year in Kansas City alone, and this saving is due solely and directly to the consolidation which took place only a few years ago. And who are the people thus benefited? It is chiefly the laboring classes who can least afford to spend their hard-earned gains unnecessarily."

The report of the treasurer showed a balance of $7,000 in hand.

There was no afternoon excursion on Tuesday, but a reception was held at the Midland Hotel in the evening.

The meeting of the street railway accountants was also begun the same day, when an address of welcome was made by Auditor Kent, of Kansas City. President Duffy made an address which was followed by extensive discussion. Mr. John I. Beggs, of Milwaukee, made an oral address on the question, "What does the general manager want to know from the accounting department?" He treated the subject in a very practical manner. He said that the head of the accounting department should be in accord with the manager's policy. He believed in making public reports of earnings and expenses.

The Wednesday session of the Association began with the reading of a paper by Mr. C. F. Bancroft, electrical engineer of the Massachusetts Electric Companies, on "A Comparison of the Various Systems of Electrical Distribution for Street Railways." The paper enumerated six different systems and discussed their various possibilities and advantages. Another paper, which was also read by the secretary, was by Mr. F. T. C. Brydges, superintendent of car shops of the Chicago Union Traction Company, on "Painting, Repainting and Maintenance of Car Bodies." There was no discussion of either paper, except by Mr. Harrington, of Camden, who made a short statement on the cost of car repairs.

In the accountants' convention a paper was presented by Mr. C. O. Simpson, auditor of the Augusta (Ga.) Railway & Electric Company, on "The Routine of a Street Railway, Electric and Gas Lighting Company." All took a hand in the discussion. On the paper by Chairman H. C. Mackay, comptroller of the Milwaukee Electric Railway & Light Company, on a "Unit of Comparison," Mr. Vreeland said that the accountants were better able than the street railway managers to decide what this unit ought to be. If any standard were adopted, it would receive his best consideration. Mr. Rossiter also spoke. It was decided to try the "car-hour" for the year and report results at the next convention. An important feature of the accountants' meeting is an exhibit of blanks and forms contained in sixteen books on a long table near the meeting room.

During Wednesday morning the ladies were given a tallyho ride to the Country Club. On Friday the supply men are to provide a vaudeville entertainment for the delegates in the convention hall.

At the Thursday morning session, Col. N. H. Heft, president of the Meriden (Conn.) Street Railway Company, read a paper on "Double-Truck Cars; How to Equip Them to Obtain Maximum Efficiency Under Varying Conditions." He recommended the use of long double-truck cars for holding 63 passengers, and weighing 473 pounds

per passenger. Plans were shown involving novel construction and a new type of truck. The paper was discussed by Messrs. Foster, of Lynn; E. Chamberlain, of Brooklyn; Harrington, of Camden; Wason, of Cleveland; Beggs, of Milwaukee; Connette, of Syracuse; Vreeland, of New York; Sergeant, of Boston; Cormick, of Cleveland, and McCulloch, of Chicago.

The election of officers for the ensuing year was taken up and resulted as follows: Walton H. Holmes, of Kansas City, president; H. H. Vreeland, of New York City, first vice-president; Col. N. H. Heft, second vice-president; J. B. McClary, Birmingham, Ala., third vice-president. Executive committee: Roach, Chicago; Fuller, Wilkesbarre; Baumhoff, St. Louis; Graham, Quincy, and Harris, Cincinnati. The place selected for the next meeting was New York City. It was also decided to limit the convention to three days, instead of four.

Walton H. Holmes.

WALTON H. HOLMES.

We give herewith a portrait of the new president of the American Street Railway Association, Mr. W. H. Holmes, who is the president of the Metropolitan Street Railway Company of Kansas City. He comes of a family that has long been associated with the management of the Kansas City street railway properties, the first horse car line in the city having been started in 1871 between Kansas City and Westport by Nehemiah Holmes, the father of the Holmes brothers, all of whom are so prominent in the affairs of the large property that has been developed from that humble beginning. The Metropolitan Company was organized in 1886, and with it may be said to have begun the modern trolley régime there. The company now has about 160 miles of road, of which 120 miles are electrical and 40 cable, the latter being marked for transformation to electricity, however, and the change having been begun already. Mr. Holmes was a member this year of the executive committee of the association and has always taken an active interest in its progress and welfare. He was chairman of the local entertainment and banquet committee for the present convention.

CONVENTION NOTES BY TELEGRAPH.

THE EXHIBITS have been shown in Convention Hall, a new building of fine proportions, which was rebuilt this year to replace an older hall on the same site that had been destroyed by fire. This hall was used for a national political convention last July, when it accommodated many thousands of people. At the convention it has been comfortably filled with exhibits and crowded by visitors circulating around the aisles between the various exhibits. A great deal of local interest has been manifested in the exhibits generally.

GUY M. GEST, of Cincinnati, showed a laid conduit.

HAROLD P. BROWN was on hand with an exhibit of his plastic bonds.

THE AMERICAN VITRIFIED CONDUIT COMPANY exhibited samples of its product.

SPEER CARBONS were on view, and Mr. J. A. Speer was in charge of the exhibit.

THE PARTRIDGE CARBON WORKS were represented by Mr. Jas. Partridge, manager.

THE W. S. ELECTRIC SIGNAL SYSTEM was represented by Messrs. F. Withee and J. J. Ruddick.

THE MORRIS ELECTRIC COMPANY had a good exhibit of all the various specialties that it represents.

THE GOULD STORAGE BATTERY COMPANY was represented by Mr. Rufus N. Chamberlain, but had no exhibit.

THE GARTON-DANIELS COMPANY had an exhibit of its arresters and of its "automotorneer" in the care of J. V. E. Titus.

THE DEARBORN DRUG & CHEMICAL COMPANY had an exhibit of its boiler cleaning specialties, in charge of Robert F. Carr.

THE CREAGHEAD ENGINEERING COMPANY, represented by Superintendent Scrugham, made a fine display of overhead material.

THE LEA ELECTRIC MFG. COMPANY, of Elwood, Ind., had an exhibit of its Elwood enclosed arc headlight, ranging from 2½ amperes up.

THE W. R. GARTON COMPANY was represented by Mr. Garton himself, who had a small and neat exhibit of his circuit breakers, etc.

THE AMERICAN STEEL & WIRE COMPANY had an exhibit of its cables and was represented by Messrs. E. J. Piozeker and H. L. Thompson.

THE OHIO BRASS COMPANY had a fine big exhibit of its trolley specialties, etc., and was represented by Messrs. King, Mead and Byrns.

LORAIN STEEL MOTORS were shown, together with trucks and some special track work, Messrs. Evans and other celebrities being in charge.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, of Cincinnati, had an exhibit including a "slow feed" controller handle. Mr. P. F. Harten was in charge.

THE PECKHAM TRUCK COMPANY had a fine exhibit of its single and double trucks, including the "Kansas City Special." Mr. Peckham was on hand with a staff of aides.

THE NATIONAL CARBON COMPANY, of Cleveland, had an exhibit of its carbon brushes, with records for long wear, and showed also its carbons for battery and arc light work.

THE CUTLER-HAMMER COMPANY was represented by C. H. Norwood and had an exhibit comprising railway switchboard panels, booster controller and a new circuit breaker.

THE DIXON CRUCIBLE COMPANY had a full line of its well-known graphite products and was represented by Messrs. S. Mayer, D. A. Johnson, W. Allen, E. A. St. John and A. L. Hasses.

THE BRILL PARLORS were at the Midland, where photographs of all kinds of work were shown. The Brill interests were represented by Messrs. G. M. Brill, Heulings, Haskell and Dean.

THE CUTTER COMPANY, of Philadelphia, was represented by Mr. V. C. Gilpin, of New York, and showed a 5000-ampere circuit breaker built for the Metropolitan Elevated Railroad, of Chicago.

THE STANDARD UNDERGROUND CABLE COMPANY was represented by Mr. J. R. Wiley, of Chicago, who showed four cabinets of samples illustrative of their complete line, and which took the medal at the Philadelphia Export Exposition.

MR. LUTHER STIERINGER, the consulting electrical engineer of the Pan-American Exposition, attended the convention observantly, with a view to the interests of that great show to be held next year, and to keep in touch with friends and acquaintances in the field.

THE GARL EXHIBIT of telephone apparatus was quite fine and drew deserved attention. It included the Garl electric block signal and telephone systems for electric roads, and its intercommunicating telephones. The exhibit was in the competent hands of Mr. Garl and Max Schumacher.

THE CHRISTENSEN ENGINEERING COMPANY had a fine air brake exhibit, including Boston elevated multiple unit equipment, a "school car" outfit, a portable compressor with hoists, etc. The whole big exhibit was in operation and was in charge of Messrs. Christensen, Hastings, Randall, Richards, Hamlin, Leet, Sutton and Beveridge.

MR. N. S. HILL, JR., general manager of the Charleston (S. C.) Consolidated Railway, Gas & Electric Company, has been ill for some time past, and was unable to be present or to prepare his paper on the storeroom and storeroom accounts. He has been on this year's executive committee of the association, and his absence is greatly regretted by many friends.

THE GOLD CAR HEATING COMPANY, of New York, had a full line of its well-known car heating apparatus. A special feature of the exhibit was a car panel heater with wrought-iron case. It weighs actually 100 pounds less per car than the cast iron type. Some switches were also shown. The exhibit was in the care of Messrs. Jas. Watson, John E. Ward and E. H. Gold.

THE H. W. JOHNS COMPANY was represented by Mr. Joseph Sachs with a nice exhibit of Noark enclosed fuses, ranging from 110 to 20,000 volts. There was also a display of Vulcabeston insulation, molded mica overhead insulators, electric heaters, Edison fuse plugs with enclosed fuse. The exhibit was in charge of Messrs. Berry, Sachs, Dickson, Perry and Bain.

MISCELLANEOUS EXHIBITORS included the Walworth Manufacturing Company, lighting fixtures; Merritt Electric Air Brake Company, Frank Ridlon Company, Rossiter, McGovern Company, Standard Paint Company, Pantasote, Green Engineering Company, W. T. Van Dorn Company, Kinnear Manufacturing Company, Duff Manufacturing Company, Auto Appliance Company, Bierbaum & Merrick Metal Company and many other concerns well known in the electric and street railway lines.

THE SPECIAL TRAINS.—A large party went out from New York over the New York Central, accompanied by General Passenger Agent

Roach as far as Albany, and thence by Agent W. H. Welch. No efforts were spared to secure the comfort of the party. A special from Boston over the Boston & Albany connected at Albany, and Mr. C. S. Blackman, of the Big Four, also went through from New York to Kansas City. From Philadelphia a special Pullman went out over the Pennsylvania Railroad. A special car over the Santa Fé from Chicago took President Roach and party.

The General Electric Company had a large space and a fine exhibit, being located near the middle of the hall. The most prominent object was the 600-kw rotary converter, built for the Kansas City Electric Light Company, with the armature on a stand in front. Another fine display was that of three 200-kw oil-cooling transformers, 6600 volts, for the same plant. The company showed also a No. 38 motor, sold to the Metropolitan Railway of Kansas City, and a No. 54 motor, sold to Omaha. There were also two No. 67 motors on a truck and a No. 73 motor for the Chicago South Side Elevated. Some other motors were also shown, and such apparatus as controllers, switchboards, car appliances, etc. The company was ably represented by Messrs. Lovejoy, Barry, Armstrong, Priest, Kalish, Beach, Pierce, Swain and Mullen.

The Westinghouse Electric & Manufacturing Company exhibited a 650-kw generator, being one of four built for the St. Louis Transit Company. The armature was shown separately; also a 5-panel switchboard, being a duplicate of that which excited so much admiration and attention at the English Tramway Exposition in London this summer. The company also showed two No. 68 motors mounted on McGuire truck, and other apparatus. A new railway motor catalogue was issued, and a pamphlet on the new motor rating adopted by the company, based on the current carried continuously for ten hours with a temperature rise not exceeding 75 degs. C. The handsome booth was draped in yellow and black bunting and carried a large Westinghouse sign in red lamps. The miscellaneous apparatus shown included Wurts lightning arresters, switches, circuit breakers, fuse blocks, voltmeters, ammeters, etc. Representing the company were Messrs. F. H. Taylor, N. W. Storer, G. Berentsen, W. H. Wells, W. M. Probasco, P. N. Jones, R. S. Brown, C. S. Powell, C. A. Bragg, J. R. Gordon, C. B. Humphrey, G. Pantaleoni, H. C. Ebert, F. C. Newell, C. F. Medbury and E. Dyer.

Comparisons of the Various Systems of Electrical Distribution for Street Railways.*

By C. F. Bancroft.

The cost of generating electric power under the same conditions, as regards fuel, depends to a great extent on the amount of power generated and the capacity of the generating apparatus with reference to the average output required. Under ordinary operative conditions, with the same power factor, that is, the same ratio of output to capacity, the cost of power per kilowatt-hour from stations of less than 500-kw capacity increases very rapidly as the station decreases in size. With from 500-kw to 1500-kw capacity, the cost of power per kilowatt-hour decreases slowly as the size of the station increases. From 1500-kw to 2500-kw capacity the cost per kilowatt-hour decreases very little as the output increases, and above 2500-kw station capacity the cost of power per kilowatt-hour becomes nearly uniform. This is due to the fact that in small plants the labor item is disproportionately large, and the general efficiency less than in larger ones, while in plants of 1500-kw output and larger the cost of labor remains proportionately nearly the same as the plant increases in size. It follows from this that there is often very little or nothing to be gained from an economical standpoint by substituting one station of 5000-kw capacity for two of 2500-kw capacity each, provided the local conditions as regards cost of coal, water, etc., are the same.

On a large system, requiring an average output of 12,000 kilowatts, even though the load be distributed within a 5-mile radius of a practical station location, it will usually be found economical to generate power at several smaller stations rather than at one large station, provided the conditions as regard cost of fuel, water and real estate are about the same, as the cost of power station buildings and machinery per kilowatt of capacity and the cost of generating power per kilowatt-hour, with a station of 5000-kw capacity, is about the same as at a station of 10,000-kw capacity. The interest on the saving in cost of feed wire by having several stations, each located near its load, would more than offset the slight saving in cost per kilowatt-hour, due to the generation of power at one large station, and it also has the advantage that in case of fire or accident to one station, the other can usually be so interconnected as to temporarily carry the entire load, and thereby avoid much of the stoppage of traffic which would occur if the road was supplied entirely from one station.

For an example of what was called the first or standard 500-volt continuous current system of distribution, a city may be cited in which the street railway lines radiate west from the centre of the city like the spokes of a half-wheel, with a radius of about 5 miles. Instead of having one large station at the hub of the wheel, the road is supplied with power from seven stations, distributed throughout the system, having an aggregate capacity of over 26,000 kilowatts.

The generating and distributing system in use in one of our most densely populated cities may be taken as an example of the way in which the system of distribution adopted is governed by conditions outside of those indicated for the most economical generation and distribution of power to the car motors. Although this system is compact and will probably require an average station output of over 30,000 kilowatts, which it would seem to the outside engineer could be more economically distributed and almost as economically generated at several stations, the street railway company is installing a high-tension alternating direct-current system of distribution with a main station of 45,000-kw ultimate capacity, and five rotary converter substations of from 3000-kw to 6000-kw capacity each. It is probable in this case that the location of the power station and the system of distribution was governed almost entirely by the great cost of real estate at points suitable for separate power stations.

It frequently happens that several miles distant from a street railway system much cheaper power is obtainable than at or near the centre of the system. This may be due to an available water power, or to a difference in the cost of fuel, etc., at two points. In cases of this kind the second, or what may be called the alternating direct-current system, is usually the most applicable. To transmit power at 500 volts in any quantity from a distance of 10 miles, or even less, is very expensive, owing to the large amount of copper required and the great loss. For instance, to deliver 500 amperes at 10 miles distance will require about 150 tons of copper, allowing a loss of about 30 per cent in the line. This same amount of power could be transmitted at 5000 volts by an alternating direct-current system with about 5 tons of copper, and with a loss of less than 10 per cent in the line.

The weight of copper required to transmit power a given distance, other things being equal, is inversely as the square of the voltage; that is to say, if it takes 100 pounds of copper to transmit a certain amount of power a given distance at 500 volts, it will only take 25 pounds of copper to transmit the same amount of power the same distance with the same loss at 1000 volts. It is owing to this fact that the alternating direct-current system is so applicable where the power has to be transmitted for any considerable distance, as it allows of the use of very high voltages on the line, 10,000 volts or more being in general use, which, by means, of transformers and rotary converters, can be reduced to 500 volts direct current for the trolley wire at points where the power is required. For an example of this system of distribution, a street railway system may be cited which derives its power from a waterfall. Here the power is generated at a pressure of 2200 volts, and is stepped up to 11,000 volts for the line. About 6000 horse-power is transmitted at this voltage for a distance of about 21 miles. The voltage is then reduced to 500 volts, direct current, by means of static transformers and rotary converters at five sub-stations, located at or near the points where the power is required.

The third system mentioned, the "booster" system, is chiefly applicable on lines where there is a light average load, but where, for short periods, an extra heavy load has to be taken care of. It would seldom be economical to supply an entire road with power by means of a booster system, as the greater part of the power generated by the booster represents wasted energy, which is usually generated in an extravagant way, as the power required to drive the booster varies as the square of the current in the feeder; that is to say, if it requires 50 horse-power to drive the booster with a load of 100 amperes, it will require 200 horse-power to drive it if the load is increased to 200 amperes. Line losses which necessitate the continuous waste of more energy than could be compensated for by an ordinary compound-wound railway generator are seldom economical, even on a portion of a system, but there are many cases where there is sufficient copper installed to take care of the average load economically, but where for a short time each day, or for a few weeks in the year, owing to local conditions, the traffic is very unusually heavy.

In cases like the above, where the heavy traffic is of short duration, a well-designed booster system may save a large investment in

*Abstract of paper read before the Am. Street Ry. Ass'n, Kansas City.

copper at a total cost of much less than would be required to pay the interest on the copper investment. For an example of this method of distribution I might cite a street railway company which supplies power to its own lines by means of a standard 500-volt direct-current system, and which also supplies power to a smaller road about 13 miles distant by means of a three-phase alternating-current system, using 5500 volts on the line. Here the booster system is used in connection with the high-tension system. When it became necessary to repair the high-tension line, it was found expensive and inconvenient to do the work between the hours of 12 midnight and 4 a. m., the only time when the power was off, and as it was not considered safe to work on the line when it was in operation, a booster system was arranged to supply power to the distant road for short periods at times of light load. A 200-kw booster was installed at the generating station and was designed to raise the voltage 1 volt per ampere of current. Switches were installed at the sub-stations so that the high-tension line could be connected directly with the 500-volt feeders, some 8 miles from generating station, and the booster was arranged so that it could be readily connected to the high-tension feeders.

When it was necessary to replace broken insulators or make other repairs on the line, the attendants were notified at the generating station and at the sub-stations, and at a prearranged signal, made by varying the voltage on the line, the alternators were thrown out and the booster thrown on in such a way that the power was only off from the trolley wire for a fraction of a minute. It was thus found quite practical to make repairs on the line while the booster was in operation, and the system proved very satisfactory for supplying power at times of light load, while repairs were being made; the load on the booster frequently running as high as 500 amperes, at which time the voltage generated by the booster was about 500, which, in addition to the 575 volts of the direct-current system, gave 1075 volts at the generating end of the line, the voltage at the sub-station averaging about 450. While it would have been very expensive to run this booster for any great length of time, for the short time it was used the total cost was much less than the interest on the copper investment required to build a duplicate line.

The fourth system mentioned, or three-wire system, is most applicable to double-track lines, where one trolley is made positive and the other negative, there being about 1000 volts potential difference between the two, the current flowing from the positive trolley wire through the car motors to the rail and from the rail through the car motors and the other track to the negative trolley. The track is usually cross-bound and also connected to the conductor or connecting the two generators, which are operated in series in the station. This connection with the track forms the third wire, and tends to equalize the voltage should there be more cars on one side of the system than on the other. This method of distribution is usually capable of saving from 20 per cent to 40 per cent in copper, according to the character of the track return. If well balanced, it also greatly reduces the electrolytic action on buried conductors, such as water pipes, etc., and is most applicable where there are excessive track losses with fair opportunities for a balanced load.

There are few roads in this country using the three-wire system of distribution, although it is used almost universally by lighting companies. This is probably due to the complications introduced in railway systems by the high voltage, usually about 1000 volts, between the trolley wire and feeders on different sides of the system and the difficulty of balancing the load. The saving in copper, while not as great as in the three-wire lighting system, is still enough to warrant the extra complication, and under favorable conditions may prove very valuable.

I am familiar with only one example of this system of distribution. In this case there is very heavy traffic over a double-track line to a park, about 6 miles from the power station. It was found impossible to handle the increased traffic on the ordinary 500-volt system with the existing feed wire. By reinsulating the line and operating it on the three-wire system, the efficiency of the distributing system was very much improved, and they were enabled to easily handle the increased traffic with the existing feed wire.

The fifth system mentioned, or the alternating-current system, is practically untried in this country. It seems peculiarly adapted to lines having long runs at uniform speed with few stops, such as lines connecting cities, rather than for ordinary street railway service. The alternating-current motors at present in general use are of the polyphase type, and require at least three working conductors, which is a serious objection in many cases for railway work, as it necessitates the use of two trolley wires in addition to the track as conductors. The disadvantages of this system appear to be the necessity for at least two trolley wires and the probable difficulty in building alternating-current motors suitable for railway work which will have a good power factor.

The main advantage of the alternating-current system is the possibility of feeding lines with stationary transformers which need no supervision, but which can be considered simply as a part of the feeder, thereby multiplying many times the length of line which can economically be supplied with power from one station. The alternating-current motor also has the advantage of running at fairly constant speed independent of the load. It will not race going down hill if the power is left on, but will return power to the line, nor will it slow down much in going up hill.

The sixth system referred to, or storage battery system, is decidedly more expensive than the usual methods of electrical distribution, owing to the great first cost and the short life of the batteries. Lead is at present the only metal capable of resisting the attacks of sulphuric acid, and modern batteries consist largely of lead, which is very undesirable from a mechanical point of view and is very heavy, so that unless the present type of storage battery is substantially improved, this system is likely to be used only where other systems are not practicable owing to peculiar local conditions or restrictions. The storage battery, however, has a large field in connection with the other systems of electrical distribution for street railways, and under favorable conditions may considerably increase the station capacity and reduce the fuel consumption; and when used on the line may greatly improve the regulation and increase the copper efficiency.

Street Railway Joints and Track.

The Pennsylvania Street Railway Association held its meeting this month and listened to various papers on different aspects of the work. One of these was by Mr. G. L. Hall, on the subject of street railway joints and track. In regard to the track itself, he laid great stress on the necessity of accurate gauging. One of the most important details of track work is the rail joint, and under average conditions it is the weakest part of track construction. The amount of wear at the joint naturally depends on traffic. Once the fastenings begin to show failure they grow rapidly worse, and, while weak, are not necessarily dangerous, but they cause a rough-riding track, increase the wear of the rails and damage the rolling stock. Much of the ultimate deterioration of joints could be avoided if there was not a general tendency to purchase cheap material and keep down the cost, and if angle-bars are used proper attention should be paid to their design and general efficiency, especially as to bearing area. A joint is simply a fastening that holds together horizontally and vertically the ends of the two rails. In addition to being held up, the rail must also be held down. This fact is apparent from the manner in which angle-bars break. Investigation shows that 90 per cent of broken angle-bars break from the top down, this being caused by the leverage of the rail, the shoulder ties acting as a fulcrum. This action is augmented by the irregularities in the wave motion. The remaining 10 per cent of broken angle-bars have been broken from the bottom up by suddenly applied loads.

One great difficulty with the joint question has been to decide which is the best design, other conditions being equal. The original outline of the angle-bar, together with some combination giving base support and adding strength, has shown the best results. If the rail and joint are of about equal strength and flexibility, the wear on the ends of the rail is true, while if the joint is stronger than the rail the wave motion is broken and the wear at the joint is irregular. If the fastening is weaker than the rail the joint will become dipped and rail and joint kinked and worn. Due allowance must be made for expansion and contraction, taking into consideration the fact that calculation of expansion and contraction must be based on the temperature of the rail itself, and not the temperature of the air at the time the rail is laid. Too much opening between the rail ends is necessarily bad, and causes pounding. At the same time, the elastic limit will not take care of great expansion and contraction. It is estimated that the loss of energy caused by the resistance to traction offered by low joints is 2 horse-power per mile of track. In addition to this there is the loss by wear and tear on cars, track material, etc. Therefore any increased outlay necessary to secure a good joint is more than balanced by the saving in the cost of maintaining the track and equipment.